Stormwater Pollution Prevention Plan
Alaskan Copper Facility
Seattle, Washington

September 29, 2011
(See Section 1.0 for record of revisions to this SWPPP)

Prepared for

Alaskan Copper & Brass Company
and Alaskan Copper Works
Seattle, Washington

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STORMWATER POLLUTION PREVENTION PLAN CERTIFICATION FORM
ALASKAN COPPER FACILITY
SEATTLE, WASHINGTON

The Permittee shall use this form to sign and certify that the Stormwater Pollution Prevention Plan (SWPPP) is complete, accurate, and in compliance with Conditions S3 and S8 of the Industrial Stormwater General Permit.

- A SWPPP certification form needs to be completed and attached to all SWPPPs.
- Each time a Level 1, 2, or 3 Corrective Action is required, this form needs to be re-signed and re-certified by the Permittee, and attached to the SWPPP.

Is this SWPPP certification in response to a Level 1, 2 or 3 Corrective Action? ☒ **Yes** ☐ **No**
If Yes:

- Type of Corrective Action?: ☒ Level 1 ☐ Level 2 ☒ Level 3
- Date SWPPP update/revision completed: 9/29/2011

"I certify under penalty of law that this SWPPP and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate information to determine compliance with the Industrial Stormwater General Permit. Based on my inquiry of the person or persons who are responsible for stormwater management at my facility, this SWPPP is, to the best of my knowledge and belief, true, accurate, and complete, and in full compliance with Permit Conditions S3 and S8, including the correct Best Management Practices from the applicable Stormwater Management Manual. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations."

James Brown — Operator's Printed Name *

Operations Mgr. — Title

James Brown — Operator's Signature *

Sept 29, 2011 — Date

* Federal regulations require this document to be signed as follows:
For a corporation, by a principal executive officer of at least the level of vice president; for a partnership or sole proprietorship, by a general partner or the proprietor, respectively; or for a municipality, state, federal, or other public facility, by either a principal executive officer or ranking elected official.

This document shall be signed by a person described above or by a duly authorized representative of that person. A person is a duly authorized representative only if: 1) The authorization is made in writing by a person described above and submitted to Ecology. 2) The authorization specifies either an individual or a position having responsibility for the overall operation of the regulated facility, such as the position of plant manager, superintendent, position of equivalent responsibility, or an individual or position having overall responsibility for environmental matters.

Changes to authorization: If an authorization under number 2 above is no longer accurate because a different individual or position has responsibility for the overall operation of the facility, a new authorization satisfying the requirements of number 2 above shall be submitted to Ecology prior to, or together with, any reports, information, or applications to be signed by an authorized representative.

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SUMMARY OF PERMIT REPORTS & SUBMITTALS

Permit Section	Submittal	Frequency	Due Date(s)
S1.F	Conditional "No Exposure" Certification Form	As necessary	As necessary
S2.B	*Application* for Permit Coverage	As necessary	As necessary
S2.B.	Request Modification of Permit Coverage	As necessary	As necessary
S2.D	Request Transfer of Coverage	As necessary	As necessary
S9.A	Discharge Monitoring Reports (DMRs)	1/quarter	within 45 days after the end of each quarter
S9.B	Annual Report	1/year	May 15th (except 2010)
S9.C.	SWPPP, if requested by *Ecology*	Per *Ecology* request	Within 14 days of request
S9.D	Noncompliance Notification	As necessary	Within 30 days of noncompliance event

SUMMARY OF REQUIRED ONSITE DOCUMENTATION

Permit Condition(s)	Document Title
S3.A.4.a	Stormwater Pollution Prevention Plan (SWPPP)
S9.B	Copies of Annual Reports
S9.C.1.a	Copy of Permit
S9.C.1.b	Copy of Coverage Letter
S9.C.1.c	Original Sampling Records (Field Notes and Laboratory Reports)
S7.C & S9.C.1.d	Site Inspection Reports
S9.C.1.j	Copies of Discharge Monitoring Reports (DMRs)

SUMMARY OF SELECTED REQUIRED ACTIVITIES

Permit Condition	Activity Description	Frequency
S7	Monthly Inspections	Qualified personnel conduct and document visual inspections of the site monthly on the monthly inspection form.
S3.B.4.b.i.5	Employee Training	Conducted at least once per year
S7	BMP Inspections	At least once per month during monthly inspections
S3.B.4.b.i.2.a	Vacuum Sweeping	Once per month or as needed but not less than once per quarter
S3.B.4.b.i.3.a	Catch Basins Cleaning	As needed when depths of debris reaches 60% of the sump depth and when the depth of debris reaches 6 inches below outlet pipe.
S3.B.4.b.i.2.d	Cover Solid Waste Storage Containers	At all times when not in use.
S7	Stormwater Observations	At least once per quarter during qualifying storm events and also during monthly inspections if conducted during a storm event
S4	Sampling	Sampling at applicable stormwater discharge locations shall be conducted at least once per quarter: 1st Quarter = January, February, and March 2nd Quarter = April, May, and June 3rd Quarter = July, August, and September 4th Quarter = October, November, and December
S9.A	DMR Submittal	Submit to Ecology within 45 days of the end of each quarter
S8	Corrective Actions	Implement: -Level One Corrective Actions (CAs) within 45 days of the end of each quarter; -and Level Two and Three CAs by Sept 30 of the following year.
S9.B	Submit Annual Report	Submit to Ecology by May 15 of each year starting in 2011.

1.0 INTRODUCTION

This document presents a Stormwater Pollution Prevention Plan (SWPPP) for the Alaskan Copper facility (the "Facility"), located in Seattle, Washington, in accordance with the requirements of Permit #WAR000139 under the State of Washington's Industrial Stormwater General Permit (ISGP) issued on October 21, 2009 and effective on January 1, 2010 (Permit). A copy of the ISGP is provided in Appendix A. This SWPPP is a continuation of Permit #SO3-000139D based on the ISGP issued on August 21, 2002 and modified on December 1, 2004, and has been updated to comply with the requirements of the October 21, 2009 ISGP.

This SWPPP is, as defined in the Permit, a "documented plan to implement measures to identify, prevent, and control the contamination of point source discharges of stormwater." In accordance with the Permit, this SWPPP contains five required SWPPP components [facility map, facility assessment, Best Management Practices (BMPs), Spill Prevention and Emergency Cleanup Plan (SPECP), and a sampling plan] and is divided into the following three main sections:

- **Facility Assessment (Section 2.0)**: Presents a general facility description, facility map, inventory of industrial activities, and inventory of materials.
- **Best Management Practices (Section 3.0)**: Describes BMPs in use or planned for use at the Facility including a listing of the Alaskan Copper pollution prevention team.
- **Stormwater Monitoring Plan (Section 4.0)**: Presents a plan for conducting quarterly stormwater sampling and monthly site inspections at the Facility.

Where applicable, the Permit Condition reference is included in parentheses throughout the text of this SWPPP for major headings and select subheadings. This document will be updated, as needed, to reflect changes to the Alaskan Copper stormwater management program, including changes in BMPs and the addition of new industrial activities or potential pollutant sources, or in response to Permit modifications. Each update will be accompanied by a newly signed SWPPP Certification Form (first page of SWPPP). A copy of this SWPPP will be maintained at the Alaskan Copper administrative offices. A list of the major revisions to previous versions of the SWPPP is presented below.

Date	Revision
November 2005	Add ROMIC Environmental Technologies, Inc. as an authorized agent
November 2007	Add Clean Harbors Environmental Services, Inc. as an authorized agent
May 2009	Update SWPPP; add Clean Harbors Environmental Services Personnel to SWPPP
July 2009	SWPPP revisions and updates
January 2010	Update SWPPP to comply with 2010 Industrial Stormwater General Permit
May 2010	Revise SWPPP to include additional operational source control and treatment BMPs
August 2010	Revise SWPPP to include additional operational source control and structural BMPs
November 2010	Revise SWPPP to include additional operational source control BMPs.
March 24, 2011	Revise SWPPP to include additional operational source control BMPs as a result of 1Q11 sample results above benchmark levels (environmentally preferable materials to be emphasized; and catch basin filters to

	be cleaned instead of replaced if filter performance poor).
July 14, 2011	Revise SWPPP to include additional operational source control BMPs as a result of 2Q11 sample results above benchmark levels (additional roof downspout filters added).
September 29, 2011	Revise SWPPP to include Appendix D technical memorandum addressing the full 2010 triggered level three corrective action stormwater treatment BMPs finalized on September 26, 2011 (oyster shells added to catch basin as treatment media). These BMPs also address the required 3Q11 level one corrective action BMP resulting from 3Q11 stormwater sample concentrations above benchmark levels. The description of the BMPs added to the SWPPP on July 14, 2011 as part of 2Q11 Level One Corrective Actions were moved from the main body of the SWPPP to Appendix D so that the full extent of 2010 Level Three Corrective Action stormwater treatment BMPs implemented at the facility are all described in Appendix D.

2.0 FACILITY ASSESSMENT (S3.B.2)

As stated in the Permit, the facility assessment includes: "a description of the facility; an inventory of facility activities and equipment that contribute to or have the potential to contribute any pollutants to stormwater; and, an inventory of materials that contribute to or have the potential to contribute pollutants to stormwater."

2.1 FACILITY DESCRIPTION (S3.B.2.a)

The Alaskan Copper Seattle Facility consists of two integrated business entities, Alaskan Copper Works, which is located at 3200 6th Avenue South and Alaskan Copper & Brass Company, which is located at 3223 6th Avenue South. Figure 1 shows the general vicinity of the Facility. The Facility has regular business hours of 7:00 a.m. to 4:00 p.m. Monday through Friday. Alaskan Copper performs dimensional steel and stainless steel pipe fabrication at the Facility. The Facility covers approximately 16.7 acres and roughly 96 percent of that area consists of buildings and paved areas. The layout of the Facility, including major buildings (628, 2958, 3200, 3223, 3300, 3301, 3317, and 3405), the Facility's stormwater discharge locations (and associated sampling identification numbers), and the storm drain system piping at the Facility are described in Section 2.1.1 below and also shown on Figure 2.

According to the Permit, facilities with a standard industrial classification (SIC) category of 34xx for fabricated metal products (Alaskan Copper Works has an SIC code of 3443, fabricated plate work – boiler shops) conduct operations and activities that are considered industrial activities requiring a stormwater permit. Industrial activities currently performed at this Facility include:

- Steel pipe forming, bending, and cutting
- Pipe welding and grinding
- Outdoor storage and transfer of materials
- Vehicle fueling
- Cutting operations
- Plasma table operations
- Vehicle maintenance

Some of these activities are limited to inside buildings and are not conducted within the stormwater drainage area. Additional details of these activities and potentially associated stormwater pollutants are provided in Worksheets 1 and 2 found in Appendix B.

2.1.1 POTENTIAL SOURCES OF STORMWATER POLLUTION (S3.B.2.b)

The following items that result from Facility operations, or that are stored at the Facility, are potential sources of stormwater pollution:

- Cutting fluid
- Lubrication grease
- Air emissions from processing
- Drummed solids from the cyclone
- Cooling fluid
- Raw or final metal products
- Facility buildings (metals from roofs or walls)

Additional details of these potential pollutants and how they could potentially become entrained in stormwater are provided in Worksheets 1 and 2 found in Appendix B.

In accordance with Permit condition S3.b.2.c.iii, this SWPPP also addresses potential stormwater pollutants from past activities, by noting that no known potential sources of pollutants from past activities, materials, and spills were previously handled, treated, stored, or disposed of in a manner to allow ongoing exposure to stormwater. There have been no known or recorded significant spills or leaks of toxic or hazardous pollutants at the Facility that migrated off-property within the last 5 years. Minor spills may have occurred inside and outside of the Facility structures, but were contained and promptly cleaned up.

To prevent potential pollutants associated with these potential sources from reaching stormwater, the Facility employs the BMPs described in Section 3.0 of this SWPPP.

2.2 STORMWATER DRAINAGE (S3.B.1.c.)

Based on storm drain utility maps provided by the City of Seattle (City), there are some portions of the Facility that drain to storm drain pipes (with ultimate discharge to a surface water body) and other portions of the Facility that drain to the combined sanitary sewer system (with ultimate discharge to a King County wastewater treatment plant). The areas where Facility stormwater runoff drains to the storm sewer are the area between Buildings 3317 and 3405 (including portions of the roofs of buildings 3317 and 3405), the area south of Building 3300 (including a portion of the roof of building 3300), the area between Buildings 3223 and 3301 including those building roofs, a portion of the paved area southwest of Building 2958, the eastern portion of Building 3200, and the Building 3200 roof and the parking area west of the building. These areas that drain to the storm sewer are shown on Figure 2. Stormwater from the remainder of the Facility drains to a combined sanitary sewer system, and the combined sewer system is also shown on Figure 2.

According to the City, stormwater exiting the Facility through the storm drain system generally flows from west to east in the City storm drain pipe south of Building 3300 (although Alaskan Copper staff recollect this storm drain line having been recently terminated off-property to allow construction of the commuter rail facility to the east). This City storm drain then turns south at 8th Avenue South, then southwest along Diagonal Avenue South, and continues southwest until just south of Idaho Street where it turns west and exits into the Duwamish River at the Diagonal Storm Drain Outfall.

The one exception to this general stormwater drainage and receiving water is the small portion of the Alaskan Copper Facility southwest of Building 2958 at the intersection of 6th Avenue South and the Hanford Street right-of-way (Alaskan Copper has authorization from the City to use this right-of-way for material storage). This small area drains to a City maintained catch basin and storm drain flow from there

is to the north with ultimate discharge to the East Waterway. This small Facility drainage area and City catch basin is not an active stormwater sampling location because the majority of the drainage to this location is from roadway runoff rather than from Alaskan Copper property and activities.

3.0 BEST MANAGEMENT PRACTICES (S3.B.4.)

The Permit identifies the following five categories of BMPs that may be needed at a facility to control stormwater discharge:

- **Operational Source Control BMPs (Section 3.1; S3.B.4.b.i.)**: These BMPs are required at all facilities covered under the Permit and are managerial-type measures that are implemented to prevent or reduce pollution of stormwater; they specifically exclude construction of pollution control measures. Examples include general housekeeping activities, formation of a pollution prevention team, and employee training.
- **Structural Source Control BMPs (Section 3.2; S3.B.4.b.ii.)**: These BMPs require construction or use of a physical structure to control pollution of stormwater. Examples include construction of a roof over a drum storage area or a containment berm around an aboveground storage tank.
- **Treatment BMPs (Section 3.3; S3.B.4.b.iii.)**: These BMPs consist of actual stormwater treatment systems designed to treat polluted stormwater. Examples include catch basin insert filters, enhanced sedimentation vault devices, and use of activated carbon to remove petroleum hydrocarbons.
- **Stormwater Peak Runoff Rate and Volume Control BMPs (Section 3.4; S3.B.4.b.iv)**: These BMPs provide stormwater detention or retention to reduce the peak rate of stormwater runoff, where necessary to minimize streambank erosion within receiving waters.
- **Erosion and Sediment Control BMPs (Section 3.5; S3.B.4.b.v)**: These BMPs are designed to limit soil erosion and to control eroded soil, and are most commonly used during site construction. Examples include seeding and covering exposed soil, and the use of silt fencing.

The following section provides a general description of the BMPs (in italics) that are required by the Permit and then describes in greater detail the specific application of these BMPs at the Facility. The BMPs contained in this SWPPP are consistent with the BMPs contained in the Washington State Department of Ecology (Ecology) 2005 *Stormwater Management Manual for Western Washington* (2005 Manual). Therefore, demonstration of BMP equivalency is not provided in this SWPPP. In addition, the 2005 Manual contains BMPs that provide all known, available, and reasonable methods of prevention, control, and treatment (AKART) of stormwater pollution to ensure that discharges do not cause or contribute to a violation of water quality standards, and comply with federal technology-based treatment requirements under 40 CFR 125.3.

The Permit lists specific operational and structural source control BMPs that must be implemented at all permitted facilities and requires permittees to implement all operational source control BMPs, structural source control BMPs, and treatment BMPs listed as "applicable" in Ecology's 2005 Manual. For Alaskan Copper, these "applicable" BMPs are found in Volume IV of the 2005 Manual, available online at: http://www.ecy.wa.gov/pubs/9914.pdf. This list, along with each BMP's potential

applicability to the Facility, is provided in Table 1. Additional descriptions of the applicable BMPs for the Facility are provided in the following sections.

3.1 OPERATIONAL SOURCE CONTROL BEST MANAGEMENT PRACTICES (S3.B.4.b.i.)

This section describes operational source control BMPs that are required by the Permit for all industrial activities and operations covered under the Permit. Recommended BMPs are also listed where applicable. Additional operational BMPs are listed in Section 3.2 for specific industrial activities and operations, where required by the Permit.

3.1.1 POLLUTION PREVENTION TEAM (S3.B.3)

Unless noted otherwise, the Facility adheres to the following pollution prevention team BMPs, applicable under the 2005 Manual.

- *The SWPPP shall identify specific individuals by name or by title within the organization (pollution prevention team) whose responsibilities include: SWPPP development, implementation, maintenance, and modification.*
  - **Pollution Prevention Team**: The Pollution Prevention Team for the Facility shall consist of the Responsible Official and the SWPPP Coordinator. The Responsible Official is the person with overall responsibility for Permit compliance, has delegated authority to sign discharge monitoring reports (DMRs) and inspection forms, and is to ensure that adequate resources are made available to the SWPPP Coordinator in order to implement the BMPs and monitoring requirements in the SWPPP. The SWPPP Coordinator has overall responsibility for developing, implementing, maintaining, and revising this SWPPP. Other Facility employees will assist the Pollution Prevention Team as necessary. Contact information for the Facility Responsible Official and SWPPP Coordinator is provided below.

PP Team Role	Name	Office Phone / Cell Phone
Responsible Official	Jim Brown	(206) 623-5800 / (b) (6)
SWPPP Coordinator	Jerry Thompson	(206) 382-8379 /

Landau Associates (425-778-0907), other environmental consulting firms, or other designated contracted personnel, may assist the Facility in SWPPP preparation, employee training, stormwater sampling, and BMP assessment services.

3.1.2 GOOD HOUSEKEEPING (S3.B.4.b.i.2)

The following good housekeeping BMPs are considered applicable in the 2005 Manual and are adhered to at the Facility, unless noted otherwise.

- *Promptly contain and clean up solid and liquid pollutant leaks and spills, including oils, solvents, fuels, and dust, from manufacturing operations on any exposed soil, vegetation, or paved area.*

- **Spills**: See Section 3.1.4 on spill prevention and cleanup.

- *Clean oil, debris, sludge, etc., from all BMP systems regularly, including catch basins, settling/detention basins, oil/water separators, boomed areas, and conveyance systems, to prevent the contamination of stormwater. Refer to the Washington State Department of Ecology's (Ecology) regional offices to assist in determining if a waste must be handled as hazardous waste.*

  - **Catch Basins**: See Section 3.2.3 on Maintenance of Stormwater Drainage and Treatment Systems.

- *Promptly repair or replace substantially cracked or otherwise damaged paved secondary containment, high-intensity parking, and any other drainage areas, which are subjected to pollutant material leaks or spills.*

- *Promptly repair or replace all leaking connections, pipes, hoses, valves, etc., that can contaminate stormwater.*

- *Sweep paved material handling and storage areas regularly, as needed, for the collection and disposal of dust and debris that could contaminate stormwater. Do not hose down pollutants from any area to the ground, storm drain, conveyance ditch, or receiving water unless necessary for dust control purposes to meet air quality regulations and unless the pollutants are conveyed to a treatment system approved by the local jurisdiction.*

In addition to these BMPs from the 2005 Manual, the Permit also specifically requires the following Good Housekeeping BMPs:

- *Vacuum paved surfaces with a vacuum sweeper (or a sweeper with a vacuum attachment) to remove accumulated pollutants a minimum of once per quarter.*

  - **Vacuum Sweeping**: Facility personnel or outside contractors inspect, clean, and maintain areas of the Facility that accumulate dust and other debris. Paved areas are vacuum-swept monthly. Sweeping the dirt and associated pollutants from paved areas of the Facility can be one of the most effective stormwater pollutant source control measures, so increasing the frequency of sweeping will be considered any time that stormwater benchmarks are found to have been exceeded.

- *Identify and control all onsite sources of dust to minimize stormwater contamination from the deposition of dust on areas exposed to precipitation.*

  - **Control of Onsite Dust**: To reduce the potential for tracking/runoff from onsite dust into storm drains between buildings 3317 and 3405, truck traffic is being eliminated from the access road between the two buildings.

- *Inspect and maintain bag houses monthly to prevent the escape of dust from the system. Immediately remove any accumulated dust at the base of exterior bag houses.*

- *Keep all dumpsters under cover or fit with a lid that must remain closed when not in use.*

The following good housekeeping BMP from the 2005 Manual is not required but recommended:

- *Recycle materials, such as oils, solvents, and wood waste, to the maximum extent possible.*

  - **Recycling**: Oil is recycled at the Facility. Waste oil for recycling is stored in an approximately 500-gallon drum on the northern side of Building 628, outside of any stormwater drainage area.

3.1.3 PREVENTIVE MAINTENANCE (S3.B.4.b.i.3)

The following preventive maintenance BMPs are considered applicable in the 2005 Manual and are adhered to at the Facility, unless noted otherwise.

- *Prevent discharge of unpermitted liquid or solid wastes, process wastewater, and sewage to ground or surface water, or to storm drains that discharge to surface water, or to the ground.*
- *Do not connect floor drains in potential pollutant source areas to storm drains, surface water, or to the ground.*
- *Conduct all oily parts cleaning, steam cleaning, or pressure washing of equipment or containers inside a building, or on an impervious contained area, such as a concrete pad. Direct rinse water and contaminated stormwater from such an area to a sanitary sewer where allowed by the local sewer authority, or to other approved treatment.*
  - **Washing**: Parts cleaning (if needed) is conducted indoors. However, if Facility personnel wash vehicles or equipment outdoors in an area that discharges to the stormwater system, they ensure that washing is conducted only where the water will be contained within a catch basin with its outlet drain plugged, and where the washwater will be pumped out to the sanitary sewer system or hauled off site for appropriate treatment. Offsite drainage of wash-water or rinse-water to surface water is not allowed.
- *Do not pave over contaminated soil unless it has been determined that groundwater has not been and will not be contaminated by the soil. Call Ecology for assistance.*
- *Construct impervious areas that are compatible with the materials handled. Portland cement concrete, asphalt, or equivalent material may be considered.*
- *Use drip pans to collect leaks and spills from industrial/commercial equipment such as airplanes, trucks, and other vehicles, which are stored outside.*
- *At industrial and commercial facilities, drain oil and fuel filters before disposal. Discard empty oil and fuel filters, oily rags, and other oily solid waste into appropriately closed and properly labeled containers, and in compliance with the Uniform Fire Code.*
- *For the storage of liquids use containers, such as steel and plastic drums, that are rigid and durable, corrosion-resistant to the weather and fluid content, non-absorbent, watertight, rodent-proof, and equipped with a close fitting cover.*
- *For the temporary storage of solid wastes contaminated with liquids or other potential pollutant materials use dumpsters, garbage cans, drums, and comparable containers, which are durable, corrosion-resistant, non-absorbent, non-leaking, and equipped with either a solid cover or screen cover to prevent littering. If covered with a screen, the container must be stored under a lean-to or equivalent structure.*
- *Where exposed to stormwater, use containers, piping, tubing, pumps, fittings, and valves that are appropriate for their intended use and for the contained liquid.*

In addition to these BMPs from the 2005 Manual, the Permit also specifically requires the following Preventive Maintenance BMPs:

- *Clean catch basins when the depth of debris reaches 60% of the sump depth. In addition, the Permittee must keep the debris surface at least 6 inches below the outlet pipe.*

- **Catch Basins**: See BMPs for the Maintenance of Storm Drain Systems (Section 3.2.3).

- *Inspect all equipment and vehicles during monthly site inspections for leaking fluids such as oil, antifreeze, etc. Take leaking equipment and vehicles out of service or prevent leaks from spilling on the ground until repaired.*

  - **Monthly Inspections**: Qualified personnel conduct and document visual inspections of the site monthly on the monthly inspection form. A blank monthly inspection form, as well as other blank forms, is provided at the beginning of Appendix C of this SWPPP. Monthly inspection criteria are the same criteria used during stormwater monitoring as described in Section 4.1.1, except that monthly inspections may occur during either storm or non-storm events, in which case monitoring of floating debris, discoloration, etc., associated with stormwater would not apply. However, monthly inspections conducted during a non-storm event may allow the inspector to observe possible illicit discharges.

- *Immediately clean up spills and leaks (e.g., using absorbents, vacuuming, etc.) to prevent the discharge of pollutants.*

  - **Spills**: See Spill Prevention and Emergency Cleanup (Section 3.1.4).

The following preventive maintenance BMP from the 2005 Manual is not required but recommended.

- *Where feasible, store potential stormwater pollutant materials inside a building or under a cover and/or containment.*

3.1.4 SPILL PREVENTION AND CLEANUP (S3.B.4.b.i.4)

The following spill prevention and cleanup BMPs are considered applicable in the 2005 Manual and are adhered to at the Facility and specifically within the facility, unless noted otherwise.

- *Immediately upon discovery, stop, contain, and clean up all spills.*

  - **Spill Prevention**: See Spill Prevention and Emergency Cleanup BMPs below.

- *If pollutant materials are stored on site, have spill containment and cleanup kits readily accessible. Place and maintain emergency spill containment and cleanup kit(s) at outside areas where there is a potential for fluid spills. These kits should be appropriate for the materials being handled and the size of the potential spill.*

  - **Onsite Spill Response Supplies**: See "Spill Kits" below.

  - **Additional Spill Cleanup Assistance**: If a spill cannot be contained on site with available resources, then the Facility will contact a spill response contractor. One such spill response contractor is NRC Environmental Services (1-800-337-7455).

- *If the spill has reached or may reach a storm sewer, groundwater, or surface water, notify Ecology immediately. Notification must comply with federal spill reporting requirements. To report a spill or to determine if a spill is a substance of a reportable quantity, call the Ecology regional office and ask for an oil spill operations or a hazardous waste specialist: Northwest Region (425) 649-7000. Ecology requires that oil spills be reported to the National Response Center (1-800-424-8802) and Washington State (1-800-258-5990 or 1-800-OILS-911). Report all non-oil spills to 1-425-649-7000. If the spill has reached or may reach a sanitary or a storm sewer, notify Ecology and the local sewer authority immediately. The local sewer authority is Seattle Public Utilities (206-684-3000).*

Spill Reporting Telephone Numbers:	
Ecology Northwest Region (all spills and information)	**(425) 649-7000**
National Response Center (oil spills)	**1-800-424-8802**
Washington State (oil spills)	**1-800-258-5990 or 1-800-OILS-911**
Seattle Public Utilities (spills to sanitary sewer)	**(206) 684-3000**

- *Do not flush absorbent materials or other spill cleanup materials to a storm drain. Collect the contaminated absorbent material as a solid and place in appropriate disposal containers.*

In addition to these BMPs from the 2005 Manual, the Permit also specifically requires the SWPPP to include a Spill Prevention and Emergency Cleanup Plan (SPECP). The SPECP is presented below and consists of the following required BMPs to prevent spills that can pollute stormwater.

- *Store all chemical liquids, fluids, and petroleum products on an impervious surface that is surrounded with a containment berm or dike that is capable of containing 10% of the total enclosed tank volume or 110% of the volume contained in the largest tank, whichever is greater.*
  - **Spill Containment**: The 300-gallon diesel tank located between Buildings 3405 and 3317 is a double-walled steel tank to provide secondary containment. A short concrete block wall surrounds the tank to provide physical protection from forklift or other impacts.
- *Prevent precipitation from accumulating in containment areas with a roof or equivalent structure or include a plan on how it will manage and dispose of accumulated water if a containment area cover is not practical.*
- *Locate spill kits within 25 feet of all stationary fueling stations, fuel transfer stations, and mobile fueling units. At a minimum, spill kits shall include: i) Oil absorbents capable of absorbing 15 gallons of fuel. ii) A storm drain plug or cover kit. iii) A non-water containment boom, a minimum of 10 feet in length with a 12-gallon absorbent capacity. iv) A non-metallic shovel. v) Two five-gallon buckets with lids.*
  - **Spill Kits**: Oil absorptive materials and spill response equipment are located near the 300-gallon diesel storage tank. Spill kits contain the minimum components listed above and are inspected monthly.
- *Do not lock shut-off fueling nozzles in the open position. Do not "topoff" tanks being refueled. Block, plug, or cover storm drains that receive runoff from areas where fueling, during fueling.*
- *Use drip pans or equivalent containment measures during all petroleum transfer operations.*
- *Locate materials, equipment, and activities so that leaks are contained in existing containment and diversion systems (confine the storage of leaky or leak-prone vehicles and equipment awaiting maintenance to protected areas).*
- *Use drip pans and absorbents under or around leaky vehicles and equipment or store indoors where feasible. Drain fluids from equipment and vehicles prior to onsite storage or disposal.*

- *Maintain a spill log that includes the following information for chemical and petroleum spills: date, time, amount, location, and reason for spill; date/time clean-up completed, notifications made and staff involved.*
  - **Spill Log**: See spill log form, Worksheet 3, in Appendix B.

3.1.5 EMPLOYEE TRAINING (S3.B.4.b.i.5)

The following employee training BMP is considered applicable in the 2005 Manual and is adhered to at the Facility, unless noted otherwise.

- *Train all employees that work in pollutant source areas in identifying pollutant sources to stormwater and in understanding pollutant control measures, spill response procedures, and environmentally acceptable material handling practices, particularly those related to vehicle/equipment liquids such as fuels, and vehicle/equipment cleaning. Use Ecology's "Stormwater Pollution Prevention Planning for Industrial Facilities" (WQ-R-93-015, 9/93) as a training reference.*
  - **Employee Training**: Alaskan Copper provides in-house training at least once per year to personnel handling stormwater issues. Training includes a review of good housekeeping BMPs, spill response procedures, and material management practices. The training covers these and other contents of this SWPPP and how employees make a difference in stormwater pollution prevention. Alaskan Copper maintains a log documenting training dates and attendees. The training log in Appendix B (Worksheet 4) will be maintained and updated. **Training will emphasize the use of environmentally acceptable materials and coatings for any equipment to be used or stored outdoors in areas where stormwater runoff enters the storm sewer rather than the sanitary sewer. The selection of appropriate materials includes paints, fencing, storage racks, roofing, and other equipment, so that use of materials containing zinc or copper will be reduced and eliminated to the extent practical. Acceptable materials would include epoxy or other non-metal paints for outdoor structures and non-galvanized storage racks or other outdoor structures. Also, as outdoor materials age and need to be replaced (such as facility roofing where apparent copper and zinc sources have been identified) to replace that material with products that will not be a source of copper or zinc to stormwater.**

3.1.6 INSPECTIONS AND RECORDKEEPING (S3.B.4.b.i.6)

The following inspection and recordkeeping BMPs are considered applicable in the 2005 Manual and are adhered to at Alaskan Copper, unless noted otherwise.

- *Verify that the descriptions of the pollutant sources identified in the stormwater pollution control program are accurate.*
  - **Pollutant Source Inspections**: As an active Facility, near-daily observations will be made by the pollution prevention team regarding the status of potential pollutant sources at the Facility. This SWPPP will be updated if new potential sources are identified and if existing potential sources are eliminated.
- *Verify that the stormwater pollutant controls (BMPs) being implemented are adequate.*

- **BMP Inspections**: This verification will be made by comparing stormwater monitoring results to benchmark values (see Section 4.4) and through near-daily observations of Facility BMPs by the pollution prevention team and other Facility personnel. In addition, BMPs will be visually inspected monthly. The BMP visual inspections will be documented on the monitoring forms provided in Appendix C.

- *Update the site map to reflect current conditions.*
  - The Site Map (Figure 2) will be updated as appropriate to show changes to the Facility that may impact stormwater discharges.

- *Include observations of the presence of floating materials, suspended solids, oil and grease, discoloration, turbidity, and odor in the stormwater discharges; in outside vehicle maintenance/repair areas; and liquid handling and storage areas. In areas where acid or alkaline materials are handled or stored, use a simple litmus or pH paper to identify those types of stormwater contaminants where needed. See procedures presented in Section 4.0 for conducting this inspection.*
  - **Stormwater Observations**: These observations will be made a part of the monthly visual monitoring as described in Section 4.1.1.

- *Determine whether there is/are unpermitted non-stormwater discharges to storm drains or receiving waters, such as process wastewater and vehicle/equipment washwater, and either eliminate or obtain a permit for such a discharge.*
  - **Unpermitted Non-stormwater Discharges:** This determination will be made as part of the monthly inspections described in Section 4. Monthly inspection forms will be maintained in Appendix C. Blank forms are also provided at the beginning of Appendix C. If Alaskan Copper identifies an unpermitted discharge, it will eliminate or obtain a permit for the discharge.

Recordkeeping BMPs require that the following reports be retained for <u>five</u> years:

- *Visual inspection reports (as described in Section 4.1.1), which should include: scope of the inspection, the personnel conducting the inspection, the date(s) of the inspection, major observations relating to the implementation of the SWPPP (performance of the BMPs, etc.), and actions taken to correct BMP inadequacies.*
  - **Recordkeeping**: Forms required as part of this SWPPP, including quarterly stormwater sampling forms and monthly inspection forms, will be maintained in Appendix C. Blank forms are also provided at the beginning of Appendix C.

- *Reports on spills of oil or hazardous substances in greater than reportable quantities (CFR Title 40 Parts 302.4 and 117), including the following: oil, gasoline, or diesel fuel that causes a violation of the State of Washington's Water Quality Standards, a film or sheen upon or discoloration of the waters of the state or adjoining shorelines, or a sludge or emulsion to be deposited beneath the surface of the water or upon adjoining shorelines.*
  - **Spill Event Recordkeeping:** Alaskan Copper will record any spill event on Worksheet 3 (Appendix B) and maintain that record for at least 5 years.

Additional records that must be kept by the pollution prevention team include the following:

- *Stormwater monitoring records* (see Section 4.2).
- *Employee training logs* (see Section 3.1.5).

Required records will be maintained in Appendix C of this SWPPP.

3.2 STRUCTURAL SOURCE CONTROL AND OPERATIONAL BEST MANAGEMENT PRACTICES BY INDUSTRIAL ACTIVITY (S3.B.4.b.ii)

This section describes structural source control BMPs and operational BMPs considered applicable in the 2005 Manual and used by the Facility for specific industrial activities within the Facility (treatment BMPs are also included for specific industrial activities where applicable). In addition, the specific industrial activities listed below are also required by the Permit to include the following structural source control BMPs to minimize the exposure of manufacturing, processing, and material storage areas to precipitation and runoff:

- *Use grading, berming, or curbing to prevent runoff of contaminated flows and divert runon away from manufacturing, processing, and material storage areas.*
- *Perform all cleaning operations indoors, under cover, or in bermed areas that prevent stormwater runoff and runon and capture any overspray. Drain washwater to a collection system for further treatment of storage.*

3.2.1 BMPs FOR FUELING AT DEDICATED STATIONS

This section describes the applicable BMPs for fueling at dedicated stations.

***General Description of Potential Pollutant Sources**: A fueling station is a facility dedicated to the transfer of fuels from a stationary pumping station to mobile vehicles or equipment. It includes above or under-ground fuel storage facilities. In addition to general service gas stations, fueling may also occur at 24-hour convenience stores, construction sites, warehouses, car washes, manufacturing establishments, port facilities, and businesses with fleet vehicles. Typically, stormwater contamination at fueling stations is caused by leaks/spills of fuels, lube oils, radiator coolants, and vehicle washwater.*

- **Applicability at Facility**: Alaskan Copper maintains a 300-gallon diesel tank between Buildings 3405 and 3317.

3.2.1.1 Operational BMPs for Fueling at Dedicated Stations

The following BMPs are required by the Permit and are adhered to at the Facility, unless noted otherwise:

- *Prepare an emergency spill response and cleanup plan (per BMPs for Spills of Oil and Hazardous Substances) and have designated trained person(s) available either on site or on call at all times to promptly and properly implement that plan and immediately cleanup all spills. Keep suitable cleanup materials, such as dry adsorbent materials, on site to allow prompt cleanup of a spill.*
  - **Spill Prevention and Cleanup**: See Section 3.1.4 for spill prevention and cleanup BMPs as part of the SPECP.
- *Train employees on the proper use of fuel dispensers. Post signs in accordance with the Uniform Fire Code (UFC). Post "No Topping Off" signs (topping off gas tanks causes*

spillage and vents gas fumes to the air). Make sure that the automatic shutoff on the fuel nozzle is functioning properly.

- *The person conducting the fuel transfer must be present at the fueling pump during fuel transfer, particularly at unattended or self-serve stations.*
- *Keep drained oil filters in a suitable container or drum.*

3.2.1.2 Structural BMPs for Fueling at Dedicated Stations

The following BMPs are required by the Permit and are adhered to at the Facility, unless noted otherwise:

- *Design the fueling island to control spills (dead-end sump or spill control separator in compliance with the UFC), and to treat collected stormwater and/or wastewater to required levels. Slope the concrete containment pad around the fueling island toward drains; either trench drains, catch basins and/or a dead-end sump. The slope of the drains shall not be less than 1 percent (Section 7901.8 of the UFC). Drains to treatment shall have a shutoff valve, which must be closed in the event of a spill. The spill control sump must be sized in compliance with Section 7901.8 of the UFC; or*
- *Design the fueling island as a spill containment pad with a sill or berm raised to a minimum of four inches (Section 7901.8 of the UFC) to prevent the runoff of spilled liquids and to prevent run-on of stormwater from the surrounding area. Raised sills are not required at the open-grate trenches that connect to an approved drainage-control system.*
  - **Drainage of Fueling Area**: The 300-gallon diesel tank is provided with double-wall secondary containment. However, the fueling area does not have a containment berm or drain to a dead-end sump. The catch basins in the area of the diesel tank have a downward facing underflow pipe that would act to contain a small volume of spilled floating diesel. That feature, in addition to the spill response kit and procedures described in Section 3.1.4, is deemed adequate for this infrequently used fueling station. However, Alaskan Copper will give future consideration to installation of a containment berm and/or a larger volume dead-end containment sump.
- *The fueling pad must be paved with Portland cement concrete, or equivalent. Asphalt is not considered an equivalent material.*
- *The fueling island must have a roof or canopy to prevent the direct entry of precipitation onto the spill containment pad. The roof or canopy should, at a minimum, cover the spill containment pad (within the grade break or fuel dispensing area) and preferably extend several additional feet to reduce the introduction of windblown rain. Convey all roof drains to storm drains outside of the fueling containment area.*
  - **Covering of fueling pad:** The small 300-gallon diesel tank is used infrequently and is not provided with a roof or canopy. However, previous stormwater sampling results from this area have shown general attainment of the previous Permit oil & grease benchmark value. A future upgrade or relocation of the diesel tank to an area under cover may be considered if future problems are found with visible oil sheens in stormwater.
- *Stormwater collected on the fuel island containment pad must be conveyed to a sanitary sewer system, if approved by the sanitary authority; or to an approved treatment system such as an oil/water separator and a basic treatment BMP (Basic treatment BMPs are listed in*

Volume V and include media filters and biofilters). Discharges from treatment systems to storm drains or surface water or to the ground must not display ongoing or recurring visible sheen and must not contain greater than a significant amount of oil and grease. Alternatively, stormwater collected on the fuel island containment pad may be collected and held for proper off site disposal.

- *Conveyance of any fuel-contaminated stormwater to a sanitary sewer must be approved by the local sewer authority and must comply with pretreatment regulations (WAC 173-216-060). These regulations prohibit discharges that could "cause fire or explosion." An explosive or flammable mixture is defined under state and federal pretreatment regulations, based on a flash point determination of the mixture. If contaminated stormwater is determined not to be explosive, then it could be conveyed to a sanitary sewer system.*

- *Transfer the fuel from the delivery tank trucks to the fuel storage tank in impervious contained areas and ensure that appropriate overflow protection is used. Alternatively, cover nearby storm drains during the filling process and use drip pans under all hose connections.*

- *If a roof or canopy is impractical the concrete fueling pad must be equipped with emergency spill control, which includes a shutoff valve for the drainage from the fueling area. The valve must be closed in the event of a spill. An electronically actuated valve is preferred to minimize the time lapse between spill and containment. Spills must be cleaned up and disposed off-site in accordance with BMPs for Spills of Oil and Hazardous Substances.*

  - **Drainage of Fueling Area**: As indicated above, a roof is considered impractical. An emergency spill control shutoff valve is not currently provided at the fueling area. Alaskan Copper will further consider installing an emergency shutoff valve for this area.

- *The valve may be opened to convey contaminated stormwater to a sanitary sewer, if approved by the sewer authority, or to oil removal treatment such as an API or CP oil/water separator, catchbasin insert, or equivalent treatment, and then to a basic treatment BMP. Discharges from treatment systems to storm drains or surface water or to the ground must not display ongoing or recurring visible sheen and must not contain greater than a significant amount of oil and grease.*

3.2.2 BMPs FOR LOADING AND UNLOADING AREAS FOR LIQUID OR SOLID MATERIAL

This section describes the applicable BMPs for loading and unloading areas for liquid or solid material.

***General Description of Potential Pollutant Sources**: Loading/unloading of liquid and solid materials at industrial and commercial facilities is typically conducted at shipping and receiving, outside storage, fueling areas, etc. Transferred materials can include products, raw materials, intermediate products, waste materials, fuels, scrap metals, etc. Leaks and spills of fuels, oils, powders, organics, heavy metals, salts, acids, alkalis, etc. during transfer are potential causes of stormwater contamination. Spills from hydraulic line breaks are a common problem at loading docks.*

- **Applicability at Facility**: The Alaskan Copper Facility loads and unloads liquid and solid materials. A 300-gallon diesel tank is located within the stormwater drainage area. A drum of solids is located within the stormwater drainage area beneath the cyclone near the southwest side of building 3317.

3.2.2.1 Operational BMPs

The following BMPs are required by the Permit and are adhered to at the Facility, unless noted otherwise:

- *A significant amount of debris can accumulate at outside, uncovered loading/unloading areas. Sweep these surfaces frequently to remove material that could otherwise be washed away by stormwater. Sweep outside areas that are covered for a period of time by containers, logs, or other material after the areas are cleared.*
  - **Sweeping**: See Section 3.1.2.
- *Place drip pans, or other appropriate temporary containment device, at locations where leaks or spills may occur such as hose connections, hose reels, and filler nozzles. Drip pans shall always be used when making and breaking connections. Check loading/unloading equipment such as valves, pumps, flanges, and connections regularly for leaks and repair as needed.*
- *To minimize the risk of accidental spillage, prepare an Operations Plan that describes procedures for loading/unloading. Train the employees, especially forklift operators, in its execution and post it or otherwise have it readily available to employees.*
- *Report spills of reportable quantities to Ecology.*
- *Prepare and implement an Emergency Spill Cleanup Plan for the facility (BMP Spills of Oil and Hazardous Substances).*

3.2.2.2 Structural BMPs

The following BMPs are required by the Permit and are adhered to at the Facility, unless noted otherwise:

- *At all loading/unloading areas: Consistent with Uniform Fire Code requirements (Appendix IV-D R.2) and to the extent practicable, conduct unloading or loading of solids and liquids in a manufacturing building, under a roof, or lean-to, or other appropriate cover.*
- *Berm, dike, and/or slope the loading/unloading area to prevent run-on of stormwater and to prevent the runoff or loss of any spilled material from the area.*
- *Large loading areas frequently are not curbed along the shoreline. As a result, stormwater passes directly off the paved surface into surface water. Place curbs along the edge or slope the edge such that the stormwater can flow to an internal storm drain system that leads to an approved treatment BMP.*
- *Pave and slope loading/unloading areas to prevent the pooling of water. The use of catch basins and drain lines within the interior of the paved area must be minimized as they will frequently be covered by material, or they should be placed in designated "alleyways" that are not covered by material, containers, or equipment.*

3.2.3 BMPs FOR MAINTENANCE OF STORMWATER DRAINAGE AND TREATMENT SYSTEMS

This section describes the operational BMPs for maintenance of stormwater drainage and treatment systems.

General Description of Pollutant Sources: *Facilities include roadside catch basins on arterials and within residential areas, conveyance systems, detention facilities such as ponds and vaults, oil and water separators, biofilters, settling basins, infiltration systems, and all other types of stormwater treatment systems presented in Volume V [of the Stormwater Management Manual]. Roadside catch basins can remove from 5 to 15 percent of the pollutants present in stormwater. When catch basins are about 60 percent full of sediment, they cease removing sediments. Oil and grease, hydrocarbons, debris, heavy metals, sediments and contaminated water are found in catch basins, oil and water separators, settling basins, etc.*

- **Applicability at Facility**: The Facility maintains catch basins and stormwater conveyance piping.

3.2.3.1 Operational and Structural BMPs

The following BMPs are adhered to at the Facility, unless noted otherwise.

- *Inspect and clean treatment BMPs, conveyance systems, and catch basins as needed, and determine whether improvements in operations and maintenance (O & M) are needed.*
  - **Catch Basins**: The Facility catch basins are equipped with catch basin fabric filter inserts, which are inspected monthly and cleaned or replaced as needed to maintain sediment levels below 60 percent of the available sediment storage capacity and also to ensure that the debris surface is at least 6 inches below the outlet pipe in order to prevent overflow of accumulated solids out of the catch basin. **During heavy rainfall months (September through April), inserts are to be cleaned (or replaced) more frequently and at least once every 2 months. If catch basins insert filters are cleaned rather than replaced, note that due to copper and zinc levels that still exceed benchmark values and because repeated cleaning of the filter fabric can cause loss of filtration performance, the catch basin insert filters will be replaced with new filter fabric once per quarter.** Notes are to be recorded on the monthly inspection form if O&M improvements are needed.
- *Promptly repair any deterioration threatening the structural integrity of the facilities. These include replacement of cleanout gates, catch basin lids, and rock in emergency spillways.*
  - **Storm Drain Blockage**: If catch basins or storm drains are observed to not drain properly and contribute to turbidity and suspended solids, then inspect drain lines for debris or sediment blockage or broken piping. Clean and repair or replace storm drain lines as necessary to restore proper drainage.
- *Ensure that storm sewer capacities are not exceeded and that heavy sediment discharges to the sewer system are prevented.*
- *Regularly remove debris and sludge from structural BMPs used for peak-rate control, treatment, etc., and discharge to a sanitary sewer, if approved by the sewer authority, or truck to a local or state government-approved disposal site.*
- *Clean catch basins when the depth of deposits reaches 60 percent of the sump depth as measured from the bottom of the basin to the invert of the lowest pipe into or out of the basin. However, in no case should there be less than 6 inches clearance from the debris surface to the invert of the lowest pipe. Some catch basins (for example, Washington State Department of Transportation Type 1L basins) may have as little as 12 inches sediment storage below the*

invert. These catch basins will need more frequent inspection and cleaning to prevent scouring. Where these catch basins are part of a stormwater collection and treatment system, the system owner/operator may choose to concentrate maintenance efforts on downstream control devices as part of a systems approach.

  - **Catch Basins**: The Facility catch basins are equipped with catch basin fabric filter inserts, which are inspected and cleaned monthly and replaced as needed to maintain sediment levels below 60 percent of the available sediment storage capacity and also to ensure that the debris surface is at least 6 inches below the outlet pipe in order to prevent overflow of accumulated solids out of the catch basin. During heavy rainfall months (September through April), inserts are to be cleaned out at least once every 2 months. The catch basin insert filters will be replaced with new filter fabric once per quarter.
  - Level Three Corrective Action Treatment BMPs: As part of the Level Three Corrective Action implemented as a response to the 2010 sampling results, a treatment BMP was installed in catch basin CB330001 as described in the technical memorandum provided in Appendix D.

- *Clean woody debris in a catch basin as frequently as needed to ensure proper operation of the catch basin.*
- *Post warning signs; "Dump No Waste – Drains to Groundwater," "Streams," "Lakes," or emboss on or adjacent to all storm drain inlets where practical.*
- *Disposal of sediments and liquids from the catch basins must comply with "Recommendations for Management of Street Wastes" from Appendix IV-G of the Stormwater Management Manual for Western Washington, available online at: http://www.ecy.wa.gov/pubs/9914.pdf.*

3.2.4 BMPs FOR ROOF/BUILDING DRAINS AT MANUFACTURING BUILDINGS

This section describes the operational BMPs for roof/building drains at manufacturing and commercial buildings.

General Description of Pollutant Sources: *Stormwater runoff from roofs and sides of manufacturing and commercial buildings can be sources of pollutants caused by leaching of roofing materials, building vents, and other air emission sources. Vapors and entrained liquid and solid droplets/particles have been identified as potential pollutants in roof/building runoff. Metals, solvents, acidic/alkaline pH, BOD, and organics, are some of the pollutant constituents identified.*

  - **Applicability at the Facility**: Alaskan Copper maintains a Building 3317 air outlet that employs a cyclone air pollution control device to remove pipe production dust and grit from the air exhaust.

The following BMPs are required by the Permit and are adhered to at the Facility, unless noted otherwise:

- *If leachate and/or emissions from buildings are suspected sources of stormwater pollutants, then sample and analyze the stormwater draining from the building. If a roof/building stormwater pollutant source is identified, implement appropriate source control measures such as air pollution control equipment, selection of materials, operational changes, material recycle, process changes, etc.*

- **Roof Drain Sampling and Response Actions**: Roof drain samples were collected in December of 2009. Based on the results of those samples, two downspout filters with metal absorption filtration media have been installed and two rain garden filtration units (stormwater planter barrels) have been installed at select downspouts between Buildings 3317 and 3405. For any future quarterly stormwater sampling conducted at CB 331707 in which copper or zinc are found to be above benchmark values, the effluent of the downspout filter units and the planter barrels will be sampled. The filter elements will be replaced and/or the topsoil in the planter barrels will be replaced within 2 months of the receipt of effluent results if zinc or copper are above the benchmark value and if metals removal rate is less than 50%. Alternatively, the downspout filter elements and planter barrel topsoil could just be replaced rather than testing their effluent.
- **Additional Roof Drain BMPs**: The description of these treatment BMPs which were added to the SWPPP on July 14, 2011 to address 2Q11 Level One Corrective Actions were moved to Appendix D on September 28, 2011 so that the full extent of 2010 Level Three Corrective Action stormwater treatment BMPs implemented at the facility are all described in Appendix D (see entry below).
- **Level Three Corrective Action Treatment BMPs:** Based on 2010 sampling results, additional treatment BMPs were installed as part of a Level 3 Corrective Action and are described in a technical memorandum provided in Appendix D. As explained in Appendix D, the treatment BMPs installed also incorporate Level One Corrective Action performed as a result of 2Q11 and 3Q11 stormwater sample concentrations above benchmark levels.
- **See also, emphasis on environmentally acceptable material (i.e., not containing leachable copper or zinc) in Section 3.1.5.**

3.2.5 BMPs FOR STORAGE OF LIQUIDS OR DANGEROUS WASTE CONTAINERS (OUTSIDE)

This section describes the BMPs required for Storage of Liquids, Food Wastes, or Dangerous Waste Containers (Outside).

General Description of Potential Pollutant Sources. *Steel and plastic drums with volumetric capacities of 55 gallons or less are typically used at industrial facilities for container storage of liquids and powders. The BMPs specified below apply to container(s) located outside a building used for temporary storage of accumulated food wastes, vegetable or animal grease, used oil, liquid feedstock or cleaning chemical, or Dangerous Wastes (liquid or solid) unless the business is permitted by Ecology to store the wastes. Leaks and spills of pollutant materials during handling and storage are the primary sources of pollutants. Oil and grease, acid/alkali pH, BOD, COD are potential pollutant constituents.*

- **Applicability at Alaskan Copper:** There is no storage of liquids, food waste, or dangerous waste containers in containers stored outdoors within the identified stormwater drainage area (with the exception of the 300-gallon diesel tank discussed separately). The BMPs are provided in this section in the event that temporary storage of liquids or dangerous wastes may need to occur in the future.

3.2.5.1 Operational BMPs

The following BMPs are required by the Permit and are adhered to at the Facility, unless noted otherwise:

- *Place tight-fitting lids on all containers.*
- *Place drip pans beneath all mounted container taps and at all potential drip and spill locations during filling and unloading of containers.*
- *Inspect container storage areas regularly for corrosion, structural failure, spills, leaks, overfills, and failure of piping systems. Check containers daily for leaks/spills. Replace containers, and replace and tighten bungs in drums as needed.*
- *Businesses accumulating Dangerous Wastes that do not contain free liquids need only to store these wastes in a sloped designated area with the containers elevated or otherwise protected from storm water run-on.*
- *Drums stored in an area where unauthorized persons may gain access must be secured in a manner that prevents accidental spillage, pilferage, or any unauthorized use.*
- *Storage of reactive, ignitable, or flammable liquids must comply with the Uniform Fire Code.*
- *Cover dumpsters, or keep them under cover such as a lean-to, to prevent the entry of stormwater. Replace or repair leaking garbage dumpsters.*
- *Drain dumpsters and/or dumpster pads to sanitary sewer. Keep dumpster lids closed. Install waterproof liners.*

3.2.5.2 Structural BMPs

The following BMPs are required by the Permit and are adhered to at the Facility, unless noted otherwise:

- *Keep containers with Dangerous Waste, food waste, or other potential pollutant liquids inside a building unless this is impracticable due to site constraints or Uniform Fire Code requirements.*
- *Store containers in a designated area, which is covered, bermed or diked, paved and impervious in order to contain leaks and spills. The secondary containment shall be sloped to drain into a dead-end sump for the collection of leaks and small spills.*
- *For liquid wastes, surround the containers with a dike. The dike must be of sufficient height to provide a volume of either 10 percent of the total enclosed container volume or 110 percent of the volume contained in the largest container, whichever is greater, or, if a single container, 110 percent of the volume of that container.*
- *Where material is temporarily stored in drums, a containment system can be used.*
- *Place containers mounted for direct removal of a liquid chemical for use by employees inside a containment area as described above. Use a drip pan during liquid transfer.*
- *Include a tank overfill protection system to minimize the risk of spillage during loading.*

3.2.6 BMPs FOR STORAGE OF LIQUIDS IN PERMANENT ABOVEGROUND TANKS

This section describes the operational, structural, and treatment BMPs for the storage of liquids in permanent aboveground storage tanks.

General Description of Pollutant Sources: *Above-ground tanks containing liquids (excluding uncontaminated water) may be equipped with a valved drain, vent, pump, and bottom hose connection.*

They may be heated with steam heat exchangers equipped with steam traps. Leaks and spills can occur at connections and during liquid transfer. Oil and grease, organics, acids, alkalis, and heavy metals in tank water and condensate drainage can also cause stormwater contamination at storage tanks.

- **Applicability at the Facility**: The 300-gallon diesel tank located between Buildings 3405 and 3317 is a double-walled steel tank to provide secondary containment. A short concrete block wall surrounds the tank to provide physical protection from forklift or other impacts.

3.2.6.1 Operational BMPs

The following BMPs are required by the Permit and are adhered to at the Facility, unless noted otherwise:

- *Inspect the tank containment areas regularly to identify problem components such as fittings, pipe connections, and valves, for leaks/spills, cracks, corrosion, etc.*
- *Place adequately sized drip pans beneath all mounted taps and drip/spill locations during filling/unloading of tanks. Valved drain tubing may be needed in mounted drip pans.*
- *Sweep and clean the tank storage area regularly, if paved.*
- *Replace or repair tanks that are leaking, corroded, or otherwise deteriorating.*
- *All installations shall comply with the Uniform Fire Code and the National Electric Code.*

3.2.6.2 Structural BMPs

The following BMPs are required by the Permit and are adhered to at the Facility, unless noted otherwise:

- *Locate permanent tanks in impervious (Portland cement concrete or equivalent) secondary containment areas surrounded by dikes or UL-approved double-walled tanks. The dike must be of sufficient height to provide a containment volume of either 10 percent of the total enclosed tank volume or 110 percent of the volume contained in the largest tank, whichever is greater, or, if a single tank, 110 percent of the volume of that tank.*
  - **Secondary Containment**: The 300-gallon diesel tank is of double-wall steel construction to provide secondary containment. The concrete wall around this tank was installed for added physical protection.
- *Slope the secondary containment to drain to a dead-end sump (optional), or equivalent, for the collection of small spills.*
- *Include a tank overfill protection system to minimize the risk of spillage during loading.*

3.2.6.3 Treatment BMPs

The following BMPs are required by the Permit and are adhered to at the Facility, unless noted otherwise:

- *If the tank containment area is uncovered, equip the outlet from the spill-containment sump with a shutoff valve, which is normally closed and may be opened, manually or automatically,*

only to convey contaminated stormwater to approved treatment or disposal, or to convey uncontaminated stormwater to a storm drain. Evidence of contamination can include the presence of visible sheen, color, or turbidity in the runoff, or existing or historical operational problems at the facility. Simple pH measurements with litmus or pH paper can be used for areas subject to acid or alkaline contamination.

3.2.7 BMPs FOR URBAN STREETS

This section describes the recommended BMPs for urban streets.

***General Description of Pollutant Sources**: Streets can be the sources of vegetative debris, paper, fine dust, vehicle liquids, tire wear residues, heavy metals (lead and zinc), soil particles, ice control salts, domestic wastes, lawn chemicals, and vehicle combustion products. Street surface contaminants have been found to contain significant concentrations of particle sizes less than 250 microns.*

- **Applicability at the Facility**: An urban street (6th Avenue South) runs north-south through the middle of the Alaskan Copper Facility.

3.2.7.1 Recommended BMPs for Urban Streets

The following BMPs are recommended, but not required, and could potentially help reduce turbidity, zinc, and other pollutants from entering the Facility stormwater system.

- *For maximum stormwater pollutant reductions on curbed streets and high volume parking lots use efficient vacuum sweepers (refer to Volume V, Ch. 12, for information about an emerging high-efficiency vacuum sweeper technology). Note: High-efficiency street sweepers utilize strong vacuums and the mechanical action of main and gutter brooms combined with an air filtration system that only returns clean air to the atmosphere (i.e., filters very fine particulates). They sweep dry and use no water since they do not emit any dust. It has been reported that high-efficiency vacuum sweepers have the capability of removing, from pavements under good condition, 80 percent or more of the accumulated street dirt particles whose diameters are less than 250 microns. This assumes pavements under good condition and reasonably expected accumulation conditions.*
- *For moderate stormwater pollutant reductions on curbed streets use regenerative air sweepers or tandem sweeping operations. Note: A tandem sweeping operation involves a single pass of a mechanical sweeper followed immediately by a single pass of a vacuum sweeper or regenerative air sweeper. A regenerative air sweeper blows air down on the pavement to entrain particles and uses a return vacuum to transport the material to the hopper. These operations usually use water to control dust. This reduces their ability to pick up fine particulates. It has been reported that these types of sweepers have the capability of removing approximately 25 to 50 percent of the accumulated street dirt particles whose diameters are less than 250 microns. This assumes pavements under good conditions and typical accumulation conditions.*
- *For minimal stormwater pollutant reductions on curbed streets use mechanical sweepers. Note: Mechanical sweepers are referred to as broom sweepers and use the mechanical action of main and gutter brooms to throw material on a conveyor belt that transports it to the hopper. These sweepers usually use water to control dust. This reduces their ability to pick up fine particulates. It has been reported that mechanical sweepers have the capability of removing only 10 to 20 percent of the accumulated street dirt particles whose diameters are*

less than 250 microns. This assumes pavements under good condition and the most favorable accumulation conditions.

- *Conduct sweeping at optimal frequencies. Optimal frequencies are those scheduled sweeping intervals that produce the most cost effective annual reduction of pollutants normally found in stormwater and can vary depending on land use, traffic volume, and rainfall patterns.*
- *Train operators in those factors that result in optimal pollutant removal. These factors include sweeper speed, brush adjustment and rotation rate, sweeping pattern, maneuvering around parked vehicles, and interim storage and disposal methods.*
- *Establish programs for prompt sweeping, removal, and disposal of debris from special events that will generate higher than normal loadings.*
- *Disposal of street sweeping solids must comply with "Recommendations for Management of Street Wastes" described in Appendix IV-G of the SWMMWW.*

3.3 TREATMENT BEST MANAGEMENT PRACTICES (S3.B.4.b.iii)

Stormwater treatment BMPs have been installed at the facility and are described in the technical memorandum provided in Appendix D.

3.4 STORMWATER PEAK RUNOFF AND VOLUME CONTROL BEST MANAGEMENT PRACTICES (S3.B.4.b.iv)

The Alaskan Copper Facility is believed to have been constructed in accordance with stormwater drainage rules in effect at the time of construction or Facility expansions. The receiving waters for stormwater runoff from the Facility that does not drain to the combined sanitary sewer system are the lower Duwamish Waterway and the East Waterway, which are large water bodies that are not subject to flow control limitations. Alaskan Copper does not maintain peak runoff and volume control BMPs beyond the existing catch basin storm drain network.

3.5 EROSION AND SEDIMENT CONTROL BEST MANAGEMENT PRACTICES (S3.B.4.b.v)

BMP options for soil erosion and sediment control at industrial sites are listed below:

- *Plant vegetative cover, such as grass, trees, and shrubs, on erodible soil areas. Cover with mats, such as clear plastic, jute, and synthetic fiber. Preserve natural vegetation, including grass, trees, shrubs, and vines.*
- *Maintain vegetated swale, dike, silt fence, check dam, gravel filter berm, sedimentation basin, and proper grading.*
  - **Soil Erosion and Sediment Control**: Alaskan Copper does not perform industrial activities on unpaved areas.

4.0 STORMWATER MONITORING PLAN (S3.B.5)

The Permit requires each facility to conduct and document visual inspections of the site and to sample and test representative stormwater discharges at least once per quarter for at least four consecutive quarters. Specific stormwater monitoring requirements are presented below.

4.1 MONITORING LOCATIONS, REQUIREMENTS, AND METHODS

In accordance with Permit Condition S7, qualified personnel are to conduct and document a visual inspection of the site each month. Each inspection shall include observations made at locations where stormwater associated with industrial activity is discharged off site to waters of the state or to a storm sewer system that drains to waters of the state. For the Alaskan Copper Facility, those locations are identified to be CB331707, CB330001, CB330102, and the City maintained catch basin southeast of Building 2958. The results of each inspection are to be recorded on the Monthly Inspection Form (Appendix C), and these completed forms are to be kept on site for Ecology review.

The ISGP requires that stormwater samples be collected and tested quarterly from location(s) that are representative of stormwater being discharged from the facility. As of July 2010, the industrial operations in Building 3223 and the north half of Building 3301 have been relocated to the Kent facility. Stormwater samples at Alaskan Copper are collected from catch basins CB331707 and CB330001, as these two locations are discharge points that discharge to storm drains rather than to the sanitary sewer and are where industrial activities occur. The locations of these two catch basins are shown on Figure 2. Sampling of stormwater must be performed according to the following Permit criteria:

- Sampling of the stormwater discharge is to be conducted at least once per quarter:

  1st Quarter = January, February, and March
  2nd Quarter = April, May, and June
  3rd Quarter = July, August, and September
  4th Quarter = October, November, and December

- Sample the stormwater discharge from the first fall storm event each year. "First fall storm event" means the first time after October 1 of each year that precipitation occurs and results in a stormwater discharge from a facility. The first fall storm event sample will complete the requirement to take a 4th Quarter sample.

- Collect samples within the first 12 hours of stormwater discharge events. If it is not possible to collect a sample within the first 12 hours of a stormwater discharge event, Facility personnel must collect the sample as soon as practicable after the first 12 hours and keep documentation with the sampling records explaining why sampling could not occur within the first 12 hours.

- Sampling need not be performed outside of regular business hours, during unsafe conditions (e.g., during thunderstorms), or during quarters where there is no discharge.

To efficiently comply with these criteria (especially the first fall sampling event), attention must be paid to weather forecasts in order to anticipate when stormwater discharge will first occur at the designated discharge location.

4.1.1 METHODS FOR VISUAL INSPECTIONS

Visual inspections include assessments of BMPs, and observations for the presence of non-permitted stormwater discharges, floating materials, visible sheen, discoloration, turbidity, or odor in the stormwater discharge at the sampling point. Visual inspection results will be recorded on the monthly inspection form provided at the beginning of Appendix C. These completed forms, referred to in the Permit as visual inspection reports, must be signed by the person making the observations as well as by Alaskan Copper's Responsible Official or other duly authorized representative of the Facility (as described in Condition G.2a of the Permit). The form includes a certification that the Facility is in compliance or non-compliance with the SWPPP and the Permit. If the Facility inspection indicates that the requirements of the SWPPP or the Permit are not being met, the monthly inspection form must include a summary of the actions that will be taken to meet these requirements. See Section S9.E of the Permit for instructions on reporting incidents of non-compliance.

4.1.2 METHODS FOR STORMWATER SAMPLING

Stormwater samples will be collected from the designated catch basin sampling locations by either reaching into the catch basin or by using a sampling pole with sampling jar affixed to the end of the pole. Stormwater samples will be obtained by submerging the sampling bottles into the stormwater flow at the drainage pipe opening without overfilling the bottles. However, if the catch basin drainage pipe inlets are submerged, the sample will be collected from the upper portion of the stormwater in the catch basin near the inlet pipe. Additional sampling protocols are listed on pages 9 and 10 of the Ecology guidance on sampling, accessible through the following link: (http://www.ecy.wa.gov/pubs/0210071.pdf).

According to the Permit requirements for this type of industrial facility, stormwater will be sampled once per quarter for the parameters listed below.

Parameter	Units	Container	Preservative	Analytical Method (Holding time)	Benchmark Value	Laboratory Quantification Level
Turbidity	NTU	500mL polyethylene bottle	None if field meter, or cool to 4°C if not brought directly to lab	Field meter or meter in lab. EPA 180.1 (48 hours)	25 NTU	0.5
pH	SU	Disposable cup	None, measure immediately	Meter or pH paper in field. pH paper within +/– 0.5 SU or less. Measure immediately.	5-9 SU	+/- 0.5
Oil Sheen	Yes/No	N/A	N/A	N/A	No visible oil sheen	N/A
Total Copper	µg/L	500 mL polyethylene bottle with acid preservative	Acid, cool to 4°C if not brought directly to lab	EPA Method 200.8 in lab (6 months)	14 µg/L	2.0
Total Zinc	µg/L	500 mL polyethylene bottle with acid preservative	Acid, cool to 4°C if not brought directly to lab	EPA Method 200.8 in lab (6 months)	117 µg/L	2.5
Total Lead	µg/L	500 mL polyethylene bottle with acid preservative	Acid, cool to 4°C if not brought directly to lab	EPA Method 200.8 in lab (6 months)	81.6 µg/L	0.5
Total Petroleum Hydrocarbons (TPH)	mg/L	Two 500 mL amber glass bottles	None, cool to 4°C if not brought directly to lab	NWTPH-Dx	10 mg/L	0.1

NTU = nephelometric turbidity unit
mL = milliliter
mg/L = milligrams per liter
µg/L = microgram per liter
SU = standard unit
EPA = U.S. Environmental Protection Agency
N/A = not applicable

In addition, during every quarter since the first quarter of 2005 under the previous ISGP and also required under the 2010 ISGP, all facilities that discharge to impaired waterbody segments listed by the state for violations of sediment standards under Section 303(d) of the Clean Water Act must conduct quarterly sampling of authorized discharges of stormwater to surface water for total suspended solids (TSS). This Facility discharges to an impaired waterbody (Duwamish Waterway) and therefore is required to include TSS as part of its quarterly sampling program. Discharges that demonstrate TSS levels consistent with effluent limits are considered unlikely to violate sediment quality standards.

Parameter	Units	Container	Preservative	Analytical Method (Holding time)	Effluent Limit	Laboratory Quantification Level
Total Suspended Solids (TSS)	mg/L	500 mL polyethylene bottle	None	EPA 160.2 (7 days)	30 mg/L	5 mg/L

Sampling requires filling appropriate containers as described above. The laboratory can provide a cooler with all the necessary sample collection jars upon request. It is recommended that a cooler with collection jars be kept on site ahead of time in preparation for qualifying rain events. The Permittee has the option of measuring pH and/or turbidity in the field with either an appropriate meter or combination of pH paper and turbidity meter. The pH can be measured by inserting a strip of pH paper (provided by the laboratory) into a disposable cup for 2 to 10 minutes and comparing the strip to the color chart. Record the result in the field notebook. If the permittee does not have appropriate field meters, the laboratory is able to analyze all necessary sampling parameters.

After filling the sample bottles with stormwater from the sample location, put the bottles into the cooler supplied by the laboratory and add ice or blue ice to cool the samples if the samples are not brought directly to laboratory. Samples from catch basins are currently labeled according to the designation listed in Section 4.4, which is based on the vicinity building name and the designated catch basin number associated with that building. For example, CB331707 denotes the 7th designated catch basin in the vicinity of building 3317.

4.2 RECORDKEEPING

Records required to be retained include the information recorded in the field during stormwater monitoring and the laboratory reports provided by the laboratory. All of the information to be recorded in the field is summarized on the Quarterly Stormwater Sampling form and Monthly Inspection form located in Appendix C. These forms, along with the laboratory data, should be kept in the recordkeeping section of this SWPPP (Appendix C). Copies of Discharge Monitoring Reports (DMRs), explained in Section 4.11, should also be kept in Appendix C. Field forms and laboratory reports must be retained for at least 5 years, according to the Permit. Blank forms including DMRs, quarterly stormwater sampling forms, and monthly inspection forms are provided at the beginning of Appendix C.

4.3 SUBMITTAL OF SAMPLES TO THE LABORATORY

Stormwater samples should be submitted to an accredited laboratory. Alaskan Copper currently uses Freidman & Bruya, Inc., which is located at:

Freidman & Bruya, Inc.
3012 16th Avenue West
Seattle, Washington 98119-2029
(206-285-8282)

The sample bottles must be labeled and the chain-of-custody (COC) form must be completed. The stormwater sample bottles should be packed in the cooler on ice if not brought directly to the

laboratory. If the cooler will leave the sampler's possession before arriving at the laboratory, place the completed COC form inside a Zip-loc bag and inside the cooler, then seal the cooler and bring the cooler to the laboratory. If the turbidity is not measured with a field meter, the sample must be brought to the laboratory as soon as possible because the sample's turbidity level needs to be analyzed by the laboratory within 48 hours of sample collection.

4.4 EVALUATION OF SAMPLING RESULTS

Three main things need to happen with the stormwater monitoring data. First, the stormwater sampling results must be submitted to Ecology on a quarterly basis (see Section 4.1). Second, the stormwater sampling results must be compared to the benchmark values shown in Section 4.1.2 to assess the effectiveness of the current BMPs in preventing pollutants from entering stormwater. Values at or below benchmark values are considered unlikely to cause a water quality violation and consistent attainment of benchmark values over four consecutive quarters, collected after January 1, 2010, suspends the need to conduct further stormwater sampling for a particular parameter (unless significant process changes take place at the Facility). Therefore, no additional action is needed if sampling results are below benchmark values, with the exception that monthly inspections must continue and DMRs still need to be submitted indicating that consistent attainment has been achieved.

Unlike exceedances of effluent limits, exceedance of benchmark values does not constitute a violation of the Permit because benchmark values are not water quality standards and are not Permit limits. However, it is an indicator that additional measures should be taken to reduce the entry of pollutants into stormwater at the Facility. These response measures range from implementing additional operational BMPs (Level One Corrective Action) to implementing stormwater treatment BMPs (Level Three Corrective Action). These Permit-required corrective actions and the criteria that trigger them are presented below.

Level One Corrective Actions – Operational Source Control BMPs

Permittees that exceed any applicable benchmark value(s) shall complete a Level 1 Corrective Action for each parameter exceeded in accordance with the following:
1. Review the SWPPP and ensure that it fully complies with Permit Condition S3, and contains the correct BMPs from the applicable Stormwater Management Manual.
2. Make appropriate revisions to the SWPPP to include additional Operational Source Control BMPs with the goal of achieving the applicable benchmark value(s) in future discharges. The Permittee shall sign and certify the revised SWPPP in accordance with S3.A.6.
3. Summarize the Level 1 Corrective Actions in the Annual Report (Condition S9.B).
4. **Level One Deadline**: The Permittee shall fully implement the revised SWPPP according to Permit Condition S3 and the applicable Stormwater Management Manual as soon as possible, but no later than the DMR due date for the quarter the benchmark was exceeded.

Level Two Corrective Actions – Structural Source Control BMPs

Permittees that exceed an applicable benchmark value (for a single parameter) for any two quarters during a calendar year shall complete a Level 2 Corrective Action in accordance with the following:
1. Review the SWPPP and ensure that it fully complies with Permit Condition S3.
2. Make appropriate revisions to the SWPPP to include additional Structural Source Control BMPs with the goal of achieving the applicable benchmark value(s) in future discharges. The Permittee shall sign and certify the revised SWPPP in accordance with S3.A.6.
3. Summarize the Level 2 Corrective Actions (planned or taken) in the Annual Report (Condition S9.B).
4. **Level 2 Deadline:** The Permittee shall fully implement the revised SWPPP according to Permit Condition S3 and the applicable Stormwater Management Manual as soon as possible, but no later than September 30th the following year. a. If installation of necessary Structural Source Control BMPs is not feasible by September 30th the following year, Ecology may approve additional time, by approving a Modification of Permit Coverage. b. If installation of Structural Source Control BMPs is not feasible or not necessary to prevent discharges that may cause or contribute to a violation of a water quality standard, Ecology may waive the requirement for additional Structural Source Control BMPs by approving a Modification of Permit Coverage. c. To request a time extension or waiver, a Permittee shall submit a detailed explanation of why it is making the request (technical basis), and a Modification of Coverage form to Ecology in accordance with Condition S2.B, by June 1st prior to the Level 2 Deadline. Ecology will approve or deny the request within 60 days of receipt of a complete Modification of Coverage request.

Level Three Corrective Actions – Treatment BMPs

Permittees that exceed an applicable benchmark value (for a single parameter) for any three quarters during a calendar year shall complete a Level 3 Corrective Action in accordance with the following:
1. Review the SWPPP and ensure that it fully complies with Permit Condition S3.
2. Make appropriate revisions to the SWPPP to include additional Treatment BMPs with the goal of achieving the applicable benchmark value(s) in future discharges. a. The Permittee shall sign and certify the revised SWPPP in accordance with Permit Condition S3.A.6. b. A licensed professional engineer, geologist, hydrogeologist, or Certified Professional in Storm Water Quality (CPSWQ) shall design and stamp the portion of the SWPPP that addresses stormwater treatment structures or processes. i. Ecology may waive the requirement for a licensed or certified professional upon request of the Permittee and demonstration that the Permittee or treatment device vendor can properly design and install the treatment device. ii. Ecology will not waive the Level 3 requirement for a licensed or certified professional more than one time during the permit cycle.
3. Summarize the Level 3 Corrective Actions (planned or taken) in the Annual Report (Condition S9.B).
4. **Level 3 Deadline**: The Permittee shall fully implement the revised SWPPP according to Permit Condition S3 and the applicable Stormwater Management Manual as soon as possible, but no later than September 30th the following year. a. If installation of necessary Treatment BMPs is not feasible by the Level 3 Deadline, Ecology may approve additional time by approving a Modification of Permit Coverage. b. If installation of Treatment BMPs is not feasible or not necessary to prevent discharges that may cause or contribute to violation of a water quality standard, Ecology may waive the requirement for Treatment BMPs by approving a Modification of Permit Coverage. c. To request a time extension or waiver, a Permittee shall submit a detailed explanation of why it is making the request (technical basis), and a Modification of Coverage form to Ecology in accordance with Condition S2.B, by June 1st prior to the Level 3 Deadline. Ecology will approve or deny the request within 60 days of receipt of a complete Modification of Coverage request.

Facilities that continue to exceed benchmarks after a Level 2 (or Level 3) Corrective Action is triggered, but prior to the Level 2 (or Level 3) Deadline, are not required to complete another Level 2 or 3 Corrective Action the following year for the same parameter. However, a Level 1 Corrective Action is required each time a benchmark is exceeded.

Finally, the results of all visual inspection data should be used to determine if action is needed to respond to the observation of visible pollutants. Response actions may include cleanup of the observed

condition and/or investigation of the source of the condition. These response actions must be documented in the monthly inspection form.

The laboratory results from the Appendix C stormwater sampling data are maintained in a separate spreadsheet database for comparison to benchmarks. The data are reviewed to track BMP effectiveness, whether benchmark concentrations are exceeded, and whether the required corrective actions in the Permit are triggered.

4.5 SUBMITTING THE SAMPLING RESULTS TO ECOLOGY

The Permit requires that the stormwater sampling results be submitted to Ecology on a quarterly basis within 45 days following the end of the reporting period. For example, fourth quarter 2010 sampling results must be submitted no later than February 14, 2011. The Facility is not required to submit visual inspection results but must retain the reports in its records as an attachment to the SWPPP. Sampling data must be summarized and submitted on a Discharge Monitoring Report form (DMR) every quarter. The DMR must be signed by a high-ranking company official in accordance with General Condition G2.a of the Permit (James Brown is the Facility's Responsible Official authorized to sign the DMR forms). Sampling data may be submitted electronically via Ecology's WebDMR system (when operable) or they can also be mailed to:

Washington State Department of Ecology
Water Quality Program – Industrial Stormwater
P.O. Box 47696
Olympia, Washington 98504-7696

DMR forms must be submitted quarterly whether or not a sample was collected. If there was no sample collected due to insufficient storm events, submit the form marking the "no discharge" check box. DMR forms must also be submitted quarterly if sampling has been suspended as a result of consistent attainment of benchmark values. If sampling has been suspended based on consistent attainment, submit the form marking the "consistent attainment" check box.

In addition, the Permittee shall submit a complete and accurate Annual Report to Ecology covering the prior year's Permit compliance activities no later than May 15 of each year (except 2010) using a form provided by or otherwise approved by Ecology. The annual report shall include corrective action documentation as required in S8.BD. If corrective action is not yet completed at the time of submission of the annual report, the Permittee must describe the status of any outstanding corrective action(s). Permittees shall retain a copy of all annual reports on site for Ecology review and shall include the following information with each annual report:

- Identify the condition triggering the need for corrective action review.
- Describe the problem(s) and identify the dates they were discovered.

- Summarize any Level 1, 2, or 3 corrective actions completed during the previous calendar year and include the dates it completed the corrective actions.
- Describe the status of any Level 2 or 3 corrective actions triggered during the previous calendar year, and identify the date it expects to complete corrective actions.

For questions about the Industrial Stormwater General Permit or DMR submittals, Clay Keown at Ecology is an available contact person (360-407-6048 or ckeo461@ecy.wa.gov). Joe Kalmar and Gary Huitsing from Landau Associates (425-778-0907) are also available to answer questions.

5.0 USE OF THIS REPORT

This Stormwater Pollution Prevention Plan has been prepared for the exclusive use of Alaskan Copper and applicable regulatory agencies. No other party is entitled to rely on the information, conclusions, and recommendations included in this document without the express written consent of Landau Associates. Further, the reuse of information, conclusions, and recommendations provided herein for extensions of the project or for any other project, without review and authorization by Landau Associates, shall be at the user's sole risk. Landau Associates warrants that within the limitations of scope, schedule, and budget, our services have been provided in a manner consistent with that level of care and skill ordinarily exercised by members of the profession currently practicing in the same locality under similar conditions as this project. We make no other warranty, either express or implied.

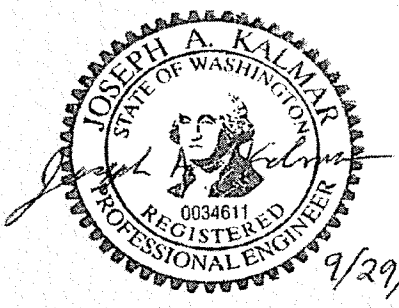
This document has been prepared under the supervision and direction of the following key staff.

LANDAU ASSOCIATES, INC.

Gary J. Huitsing
Project Engineer, P.E.

Joseph A. Kalmar, P.E.
Principal

JAK/GJH/kes



9/29/11

STORMWATER POLLUTION PREVENTION PLAN CERTIFICATION FORM
ALASKAN COPPER FACILITY
SEATTLE, WASHINGTON

The Permittee shall use this form to sign and certify that the Stormwater Pollution Prevention Plan (SWPPP) is complete, accurate, and in compliance with Conditions S3 and S8 of the Industrial Stormwater General Permit.

- A SWPPP certification form needs to be completed and attached to all SWPPPs.
- Each time a Level 1, 2, or 3 Corrective Action is required, this form needs to be re-signed and re-certified by the Permittee, and attached to the SWPPP.

Is this SWPPP certification in response to a Level 1, 2 or 3 Corrective Action? ☒ **Yes** ☐ **No**
If Yes:

- Type of Corrective Action?: ☒ Level 1 ☐ Level 2 ☒ Level 3
- Date SWPPP update/revision completed: 9/29/2011

"I certify under penalty of law that this SWPPP and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate information to determine compliance with the Industrial Stormwater General Permit. Based on my inquiry of the person or persons who are responsible for stormwater management at my facility, this SWPPP is, to the best of my knowledge and belief, true, accurate, and complete, and in full compliance with Permit Conditions S3 and S8, including the correct Best Management Practices from the applicable Stormwater Management Manual. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations."

James C Brown — Operator's Printed Name *

Operations Mgr. — Title

James Brown — Operator's Signature *

9/29/11 — Date

*Federal regulations require this document to be signed as follows:
For a corporation, by a principal executive officer of at least the level of vice president; for a partnership or sole proprietorship, by a general partner or the proprietor, respectively; or for a municipality, state, federal, or other public facility, by either a principal executive officer or ranking elected official.

This document shall be signed by a person described above or by a duly authorized representative of that person. A person is a duly authorized representative only if: 1) The authorization is made in writing by a person described above and submitted to Ecology. 2) The authorization specifies either an individual or a position having responsibility for the overall operation of the regulated facility, such as the position of plant manager, superintendent, position of equivalent responsibility, or an individual or position having overall responsibility for environmental matters.

Changes to authorization: If an authorization under number 2 above is no longer accurate because a different individual or position has responsibility for the overall operation of the facility, a new authorization satisfying the requirements of number 2 above shall be submitted to Ecology prior to, or together with, any reports, information, or applications to be signed by an authorized representative.

TECHNICAL MEMORANDUM

LANDAU ASSOCIATES
ENVIRONMENTAL | GEOTECHNICAL | NATURAL RESOURCES

TO: James Brown and Jerry Thompson, Alaskan Copper

FROM: Joseph Kalmar, PE and Gary Huitsing, PE

DATE: September 29, 2011

RE: LEVEL THREE CORRECTIVE ACTIONS AND STORMWATER TREATMENT BMPS ALASKAN COPPER FACILITY – SEATTLE, WASHINGTON

This technical memorandum addresses stormwater treatment structures implemented as a result of Level Three Corrective Action requirements of the Permit. As described in the 2010 Annual Report for this facility, copper and zinc exceeded Permit benchmark values for at least three quarters during 2010 and therefore triggered the need to implement stormwater treatment best management practices (BMP) by September 30, 2011. The following requirements for Level Three Corrective Actions are from Section S8.D of the Permit.

Each Permit requirement listed below (shown in bulleted italic format) is followed by a description of how the requirement was addressed by the facility:

- *Permittees that exceed an applicable benchmark value (for a single parameter) for any three quarters during a calendar year shall complete a Level 3 Corrective Action in accordance with the following: 1. Review the SWPPP and ensure that it fully complies with Permit Condition S3.*

  – **Review SWPPP**: The SWPPP is reviewed regularly, at least annually as part of the preparation of the Annual Report to the Washington State Department of Ecology.

- *2. Make appropriate revisions to the SWPPP to include additional Treatment BMPs with the goal of achieving the applicable benchmark value(s) in future discharges. a. The Permittee shall sign and certify the revised SWPPP in accordance with S3.A.6. b. A licensed professional engineer, geologist, hydrogeologist, or Certified Professional in Storm Water Quality (CPSWQ) shall design and stamp the portion of the SWPPP that addresses stormwater treatment structures or processes. i. Ecology may waive the requirement for a licensed or certified professional upon request of the Permittee and demonstration that the Permittee or treatment device vendor can properly design and install the treatment device. ii. Ecology will not waive the Level 3 requirement for a licensed or certified professional more than one time during the permit cycle.*

  – **Revise SWPPP**: The SWPPP was revised on July 14, 2011 and again on September 29, 2011 to include this technical memorandum documenting the addition of treatment BMPs described below (downspout filters, rain gardens, and catch basin oyster shell treatment media). The goal of these BMPs is to improve the ability of the facility to meet the benchmark levels, the success of which shall be evaluated through continual quarterly monitoring and comparison of sample concentrations to benchmark levels. The Treatment BMPs implemented (described in more detail below) have been shown to reduce metals concentrations. Documentation of these treatment approaches include *Dynaphore Inc., Forager™ Sponge Technology* (EPA 540/R-94/522a, February 1995) provided by CleanWay (included in Attachment 1); *Oystershells in StormFilters-Technical Memorandum* (Taylor Associates, December 31, 2008); and previous onsite stormwater treatment performance sampling. Some of the initial onsite tests at Alaskan Copper of two of the treatment units

described below (downspout filters and rain gardens) show that these treatment units can be successful at removing up to 99 percent of copper and up to 93 percent of zinc from stormwater (see Attachment 2). In addition, tests at another facility where oyster shells were installed in catch basins show a 71 percent reduction of copper and a 73 percent reduction of zinc in stormwater after oyster shells were installed (Attachment 4).

- *3. Summarize the Level 3 Corrective Actions (planned or taken) in the Annual Report (Condition S9.B).*

  - **Summary of Annual Report Corrective Actions Planned or Taken**: Existing downspout filters and self-contained rain garden filtration units (stormwater planters) installed in May 2010 have helped achieve benchmark values for turbidity and have reduced metals concentrations. Effluent testing from these treatment units used to treat roof runoff has shown that effluent metals concentrations are variable but that these units are capable of effectively removing zinc and copper and capable of achieving the benchmark values. Therefore, expansion of the use of these treatment technologies was considered in the annual report. Additional BMPs considered included roof encapsulation using epoxy paint or other coating method for buildings on the west side of the facility (which drain to CB331707) that have zinc and copper sources in roofing materials. An adsorbent media catch basin insert filter for CB330001, and full replacement of catch basin insert filters (rather than just filter fabric cleaning) to be performed at least quarterly were also BMPs considered. Each of these treatment options listed in the 2010 Annual Report are addressed below:

    - **Downspout Filters and Rain Garden Filtration Units:** The facility implemented downspout filters with metal adsorption filtration media and self-contained rain garden filtration units (stormwater planters) at select roof downspouts at Buildings 3317 and 3405. Two downspout metals adsorption units and two planter rain garden barrels for downspout stormwater treatment were installed at Buildings 3317 and Building 3405 in May 2010. One additional downspout filter and four additional rain garden filtration units were installed on July 13, 2011. The downspout filter and three of the four rain gardens were installed at selected downspouts between buildings 3317 and 3405 in response to copper and zinc benchmark exceedances measured at CB 331707 during the second quarter of 2011. One of the rain garden systems was installed at a downspout from building 3300 in response to a copper benchmark exceedance at CB 330001. The attached Rain Garden Specifications (Attachment 4) and Stormwater Planter List (Attachment 5) were incorporated into construction of the downspout filter rain garden units. Modeling of water quality design treatment storm events using the Western Washington Hydrologic Model, Version 3 (WWHMv3), and when considering the specifications of the rain garden planter, suggests that approximately 3.6 square ft of rain garden surface area is needed for every 100 square feet of roof area to be treated. Alaskan Copper limited the final as-built sizing of rain gardens due to available space at the facility.

    - **Catch Basin Adsorbent Media**: Catch basin structural modifications were made and oyster shell media was installed in CB330001 on September 22-26, 2011. The catch basin was modified similar to as shown on the figure in Attachment 6, with a vertical pipe providing a perforated underdrain to ensure stormwater flow through the shell media and with a threaded end cap to allow for sampling. Oyster shells (as described in the reference citation above) can buffer pH levels in stormwater to a less acidic level less favorable to the solubility of metals and acting to adsorb metals in the calcium carbonate matrix of the shell.

- **Catch Basin Insert Filter Replacement Intervals**: Starting with the second quarter of 2011, when pollutant levels in stormwater exceeded benchmark levels, catch basin inserts are now replaced quarterly with new filter fabric elements instead of just being cleaned and reused.
- **Roof Encapsulation:** As described in the annual report, metals source elimination via roof encapsulation was evaluated and offered the best potential for reduction of metals in stormwater runoff. However, because the cost for sealing of roofs was determined to be very high it was not deemed financially viable alternative by Alaskan Copper an d stormwater treatment was installed instead.

- *4. Level 3 Deadline: The Permittee shall fully implement the revised SWPPP according to Permit Condition S3 and the applicable Stormwater Management Manual as soon as possible, but no later than September 30th the following year. a. If installation of necessary Treatment BMPs is not feasible by the Level 3 Deadline; Ecology may approve additional time by approving a Modification of Permit Coverage. b. If installation of Treatment BMPs is not feasible or not necessary to prevent discharges that may cause or contribute to violation of a water quality standard, Ecology may waive the requirement for Treatment BMPs by approving a Modification of Permit Coverage. c. To request a time extension or waiver, a Permittee shall submit a detailed explanation of why it is making the request (technical basis), and a Modification of Coverage form to Ecology in accordance with Condition S2.B, by June 1st prior to the Level 3 Deadline. Ecology will approve or deny the request within 60 days of receipt of a complete Modification of Coverage request.*

  - **September 30, 2011 Deadline:** The revised SWPPP has been implemented prior to this deadline and no extension or waiver request was made to Ecology.

In addition, the Permit also requires the following:

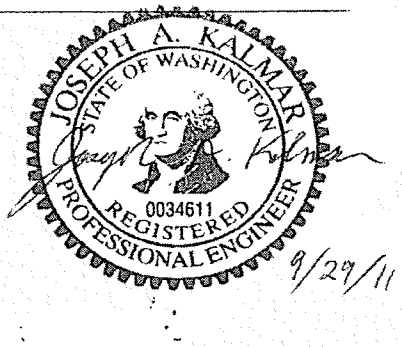
- *Facilities that continue to exceed benchmarks after a Level 3 Corrective Action is triggered, but prior to the Level 3 Deadline, are not required to complete another Level 2 or 3 Corrective Action the following year for the same parameter. However, a Level 1 Corrective Action is required each time a benchmark is exceeded.*

  - **Level One Corrective Actions**: Alaskan Copper will continue to perform Level One Corrective Actions as may be necessary in the future.

Name of Registered Professional Engineer: Joseph A. Kalmar

Signature of Registered Professional Engineer: Joseph A. Kalmar

Date: 9/29/11 Registration # 34611 State: Washington



ATTACHMENTS

Attachment 1: *Dynaphore Inc., Forager™ Sponge Technology* (EPA 540/R-94/522a, February 1995)
Attachment 2: 2010 Downspout Stormwater Treatment Testing Results
Attachment 3: Oyster Shell Treatment Effectiveness
Attachment 4: Rain Garden Planter Specifications
Attachment 5: Rain Garden Planter Plant-List
Attachment 6: Oyster Shell Catch Basin Drainage Configuration

ATTACHMENT 1

Dynaphore Inc., ForagerTM Sponge Technology (EPA 540/R-94/522a, February 1995)

United States Environmental Protection Agency | Office of Research and Development Cincinnati, OH 45268 | EPA 540/R-94/522a February 1995

EPA

SITE Technology Capsule

Dynaphore, Inc., Forager™ Sponge Technology

Introduction

In 1980, the U.S. Congress passed the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), also known as Superfund, committed to protecting human health and the environment from uncontrolled hazardous wastes sites. CERCLA was amended by the Superfund Amendments and Reauthorization Act (SARA) in 1986 - amendments that emphasize the achievement of long-term effectiveness and permanence of remedies at Superfund sites. SARA mandates implementing permanent solutions and using alternative treatment technologies or resource recovery technologies, to the maximum extent possible, to clean up hazardous waste sites.

State and federal agencies, as well as private parties, are now exploring a growing number of innovative technologies for treating hazardous wastes. The sites on the National Priorities List total over 1,700 and comprise a broad spectrum of physical, chemical, and environmental conditions requiring varying types of remediation. The U.S. Environmental Protection Agency (EPA) has focused on policy, technical, and informational issues related to exploring and applying new remediatin technologies applicable to Superfund sites. One such initiative is EPA's Superfund Innovative Technology Evaluation (SITE) program, which was established to accelerate development, demonstration, and use of innovative technologies for site cleanups. EPA SITE Technology Capsules summarize the latest information available on selected innovative treatment and site remediation technologies and related issues. These capsules are designed to help EPA remedial project managers, EPA on-scene coordinators, contractors, and other site cleanup managers understand the types of data and site characteristics needed to effectively evaluate a technology's applicability for cleaning up Superfund sites.

This capsule provides information on the Dynaphore, Inc. Forager™ Sponge technology, a technology developed to remove heavy metal contaminants from groundwater, surface waters, and process waters. The Forager™ Sponge process was evaluated under EPA's SITE program In April 1994, at the NL Industries, Inc. Superfund Site in Pedricktown, NJ. The site was originally a secondary lead smelting facility. The groundwater at the facility Is contaminated with heavy metals, including lead, cadmium, and chromium in excess of NJ groundwater standards. Information In the Capsule emphasizes specific site characteristics and results of the SITE field demonstration at the NL Industries, Inc. site. This capsule presents the following Information:

- Abstract
- Technology Description
- Technology Applicability
- Technology Limitiations
- Process Residuals
- Site Requirements
- Performance Data
- Technology Status
- Source of Further Information

Abstract

The Forager™ Sponge is a volume reduction technology in which heavy metal contaminants from an aqueous medium are selectively concentrated into a smaller volume for facilitated disposal. The technology treats contaminated groundwater, surface waters, and process waters by absorbing dissolved ionic species onto a sponge matrix. The sponge matrix can be directly disposed, or regenerated with chemical solutions. The Sponge can remove toxic heavy metals from waters in the presence of high concentrations of innocuous, naturally occurring dissolved inorganic species.

SITE
SUPERFUND INNOVATIVE TECHNOLOGY EVALUATION

The Forager™ Sponge technology was demonstrated under the SITE Program at the NL Industries, Inc. Superfund site in Pedricktown, NJ. The mobile pump and treat system treated groundwater contaminated with heavy metals. The demonstration focused on the system's ability to remove lead, cadmium, chromium, and copper from the contaminated groundwater over a continuous 72-hr test. The results from the demonstration indicated that cadmium was reduced by 90%, copper reduced by 97%, lead reduced by 97%, and chromium reduced by 32%. The removal of heavy metals proceeded in the presence of significantly higher concentrations of innocuous cations such as calcium, magnesium, sodium, potasslum, and aluminum.

The Forager™ Sponge technology was easy to operate and exhibited no operational problems over the course of the demonstration. The system is trailer-mounted, easily transportable, and can be operational within a day upon arrival at a site. The spent Sponge can be compacted into a small volume for easy disposal.

The Forager™ Sponge technology was evaluated based on the seven criteria used for decision making as part of the Superfund Feasibility Study (FS) process. Results of the evaluation are summarized in Table 1.

Technology Description

The Forager™ Sponge is an open-celled cellulose sponge which contains a water-insoluble polyamide chelating polymer for the selective removal of heavy metals. The polymer is intimately bonded to the cellulose so as to minimize physical separation from the supporting matrix. The functional groups in the polymer (i.e., amine groups in the polymer backbone and pendent carboxyl groups) provide selective affinity for heavy metals in both cationic and anionic states, preferentially forming coordination complexes with transition-group heavy metals (groups IB through VIIIB of the Periodic Table). The order of affinity of the polymer for metals is influenced by solution parameters such as pH, temperature, and total ionic content. The following affinity sequence for several representative ions is generally expected by Dynaphore:

$Cd^{++} > Cu^{++} > Fe^{+++} > Au^{+++} > Mn^{++} > Zn^{++} > Ni^{++} > Co^{++} > Pb^{++} > Au(CN)_2^- > SeO_4^{-2} > AsO_4^{-3} > Hg^{++} > CrO_4^{-2} > UO_4^{-2} > Ag^+ > Al^{+++} > K^+ > Ca^{++} > Mg^{++} >> Na^+$

The high selectivity for heavy metals, and the low selectivity for alkali and alkaline earth metals (Na+, K+, Mg++, and Ca++), is especially useful for the treatment of contaminated natural waters which may contain high concentrations of these innocuous chemical species. These monovalent and divalent cations do not interfere with or compete with absorption of heavy metals, therefore allowing for maximum removal of heavy metals from contaminated waters.

The Sponge is highly porous which promotes high rates of absorption of ions. Absorbed ions can be eluted from the Sponge by techniques typically employed for regeneration of ion exchange resins. Following elution. the Sponge is ready for the next absorption cycle. The useful life of the media depends on the operating environment and the elution techniques used. Where regeneration is not desirable or economical, the Sponge can be compacted to an extremely small volume to facilitate

Table 1. FS Criteria Evaluation for the Forager ™ Sponge Technology

FS Criteria						
Overall Protection of Human Health and the Envkonment	*Compliance with federal ARARs*	*Long-Term Effectiveness and Permanence*	*Reduction of Toxicity Mobility. or Volume Through Treatment*	*Short-Term Effectiveness*	*Implementability*	*Cost*
Protects human health and the environment by removing contaminants from groundwater or surface water.	*Requires compliance with RCRA treatment. storage. and disposal regulations and pertinent radioactive and mixed waste regulations.*	*Permanently removes contamination from the affected matrix.*	*Volume reduction technology which transfers contaminants from aqueow media to a smaller volume.*	*Presents minimal risk to workers and the community*	*Easily implementable and transportable.*	*$340/1,000 gal with regenerate :on.*
Minimizes or eliminates the further spread of contaminants within the aquifer.	*Well construction activities may require permits.*	*Residuals from the process must be disposed of in an appropriate manner.*	*Ability to compact Sponges to small volumes may be advantageous for radioactive or mixed waste.*		*Requires minimal site preparation and utilities (water & electricity).*	*$238/1,000 gal with Sponges regenerated twice providing for 3 useful cycles.*
	Disposal of treated waters may requkw compliance with Clean Water Act and Safe Drinking Water Act.					

**Actual cost of a remedial technology is site-specific and is dependent on factors such as the cleanup level, contaminant concentrations and types, waste characteristics, and volume necessary for treatment.*

disposal. The metal-saturated Sponge can also be incinerated with careful attention given to the handling of resultant vapors.

The Sponge can be used in columns, fishnet-type enclosures, or rotating drums. For this demonstration, the Sponge was utilized in a series of four columns. Each column was comprised of a 1.7 ft^3, pressurized acrylic tube containing about 24,000 half-in. Sponge cubes contained within a fishnet bag. The columns were mounted on a mobile trailer unit.

Technology Applicability

The Forager™ Sponge is capable of removing dissolved heavy metals from a wide variety of aqueous media including groundwater, surface waters, landfill leachate and industrial effluents. The chemistry employed for metal removal is selective, allowing for the treatment of toxic heavy metals in the presence of high concentrations of innocuous cations, such as Ca++, Mg++, Na+, and K+. The selective affinity of the polymer is similar to commercially available selective chelating resins. However, the Sponge's unique supporting cellulosic matrix may provide the technology with distinct advantages under certain processing conditions.

The Forager™ Sponge could be potentially incorporated into varied treatment configurations. The technology can be utilized in a conventional pump-and-treat remedial process, as was performed during the SITE Demonstration. The Sponge can be utilized as the primary or secondary removal mechanism, dependent on the type and concentration of contaminants, as well as the properties of the influent wastestream. For example, the Sponge may be used as a polishing step in conjunction with a technology that can remove high concentrations of metals to moderate levels (e.g., chemical precipitation). According to the developer, the Forager™ Sponge technology can also be used in applications requiring in-situ treatment. In these applications, the Sponge can be placed into tubular fishnet containers and emplaced within wells or trenches to intercept groundwater flow. The Sponge can be used to treat surface waters by placing the Sponge in a fishnet configuration across channels or within other surface water bodies.

In addition, to potential different treatment applications, the Sponge's unique matrix provides advantages in terms of disposal and operating conditions. The metal-laden Sponge can also be compacted into small disposal volumes, which could aid in lowering disposal costs, and is beneficial where a minimum volume of residual waste is needed due to the properties of the contaminants being absorbed. For example, this may be advantageous in the treatment of radiologically contaminated waters, where the need to minimize residual waste is a critical disposal issue.

The high porosity of the Sponge enables a low pressure system to be used. For this demonstration, the four column unit operated under an inlet pressure as low as 4.4 psig. Although not demonstrated, if sufficient head were provided, the system could have operated by gravity flow.

Technology Limitations

The technology is considered a volume reduction technology since the contaminants are removed from the waste stream and concentrated into a smaller volume which can be more easily handled and disposed. The reduced volume, either sponge or acid regenerant solution, must be immobilized by other means on-site or off-site.

According to the developer, the scope of contaminants suitable for treatment using the Dynaphore Inc. Forager™ Sponge Technology is limited to heavy metals. The technology's affinity and absorption capacity for given metals can vary and is dependent on a number of waste characteristics including pH, concentration and types of cations and anions present, and the presence of complexing agents.

The technology usefulness may be limited by its overall absorption capacity for the heavy metals of concern. If frequent changeout or regeneration of the columns is required, it could make this technology cost prohibitive. In these applications. pretreatment may be necessary in order to reduce the concentration of specific contaminants to technically and/or economically optimal levels.

Process Residuals

The residuals generated from the Sponge technology consist of either solid sponge material or liquid (acid) regenerant solution. These residuals will be concentrated with heavy metals, and depending on contaminant levels, may be subject to RCRA regulations as a hazardous waste. These waste materials can be easily stored in appropriate 55-gal drums for off-site transport and disposal. For the demonstration, four Sponges were hand compacted into one 55-gal drum. Further compaction is possible utilizing a waste compactor. Following completion of the demonstration, the developer sent four fishnet bags of virgin Sponges to a waste compacting firm to determine maximum compaction achievable. Tests performed revealed compaction ratios of 4: 1 and 10: 1 utilizing compaction forces of 20,000 lb and 85,000 lb, respectively.

Treated wastewater can be discharged to a Publicly Owned Treatment Work (POTW), into surface waters, or reinjected through underground injection wells, if appropriate discharge limitations are met and the proper permits are obtained, For this demonstration, the treated effluent was suitable for off-site treatment at a local POTW.

Site Requirements

The Forager™ Sponge treatment unit is mounted on a flat bed trailer and is easily transportable. The four-column trailer unit, measuring approximately 50 ft^2, is equipped with a water heater, wastewater pump, flow

meter and totalizer. Once on site, the treatment system can be operational within a day, if all necessary facilities utilities and supplies are available. On-site assembly and maintenance requirements are minimal.

Utilities required for the trailer unit are limited to water and electricity. Electricity requirements are dependent upon the need to pump the wastewater, if gravity feed is not feasible, and the need to heat the wastewater to improve absorption of metals. The water can be pumped with the 12-V pump equipped on the trailer. This pump can also run off a car battery, which was done for the demonstration. The water heater requires a 220-V electrical outlet. Water will be required occasionally for regeneration of the Sponges, cleanup and decontamination.

Support facilities include an area for untreated and treated groundwater storage tanks (if used), a chemical storage area for regenerant chemicals (i.e. acids) and any other process chemicals, and a waste drum storage area for spent Sponges, regenerant solutions and other wastes requiring disposal. These areas must be constructed to control run-on and run-off. Additionally, an enclosed building or shed may be necessary to protect equipment and personnel from weather extremes. During the demonstration, the treatment unit was housed in a tent. Mobile office trailer(s) may also be needed on site.

Support equipment for the Forager™ Sponge Technology may include a drill rig for well installation, containers for waste storage, a forklift for moving waste drums, and a waste compactor for compaction of Sponges. In addition to an influent equalization tank, a treated storage tank may be needed if the water can not be directly discharged to a POTW or stream, or reinjected into the ground.

Performance Data

The Forager™ Sponge Technology was evaluated for its ability to remove heavy metals from groundwater. Lead, cadmium, and chromium are contaminants of concern at the NL site, and are therefore the critical parameters for this study. In addition, copper was also considered a critical parameter because of the high removal efficiency observed in predemonstration treatability tests.

The developer claimed that the technology would achieve at least a 90% reduction of lead and copper, an 80% reduction in cadmium, and a 50% reduction of chromium (as trivalent chrome) in the groundwater.

In addition to the primary objective, other secondary (non-critical) objectives included:

- determine removal efficiencies for other heavy metals present in the groundwater;
- determine removal efficiencies for critical parameters across the four columns;
- evaluate the absorption capacity and regenerative capabilities of the Sponge for the critical parameters;
- gather information to estimate operating costs, (e.g., utility and labor requirements, waste disposal costs, treatment capacity, etc.).

The technology was evaluated over a continuous 72-hr operational period, resulting in a total treatment volume of approximately 4,300 gal. Groundwater was pumped from the influent storage tank through the four-column system at a treatment flow rate of 1 gpm or 0.08 bed volumes/min. The influent temperature was raised approximately 15° C to increase reaction rates (i.e.,improve absorption of the critical metals). The treated effluent was initially discharged to a 250 gal portable tank from which it was subsequently pumped to a 20,000 gal effluent storage tank. The stored effluent was transported off-site for treatment at a local POTW. A flow schematic of the system is shown in Figure 1.

According to the developer, replacement or regeneration of the columns was not necessary, since none of the columns were anticipated to become saturated (i.e., no further absorption capacity available for the critical metals). Four columns were reportedly needed to provide sufficient path length to meet the demonstration goals.

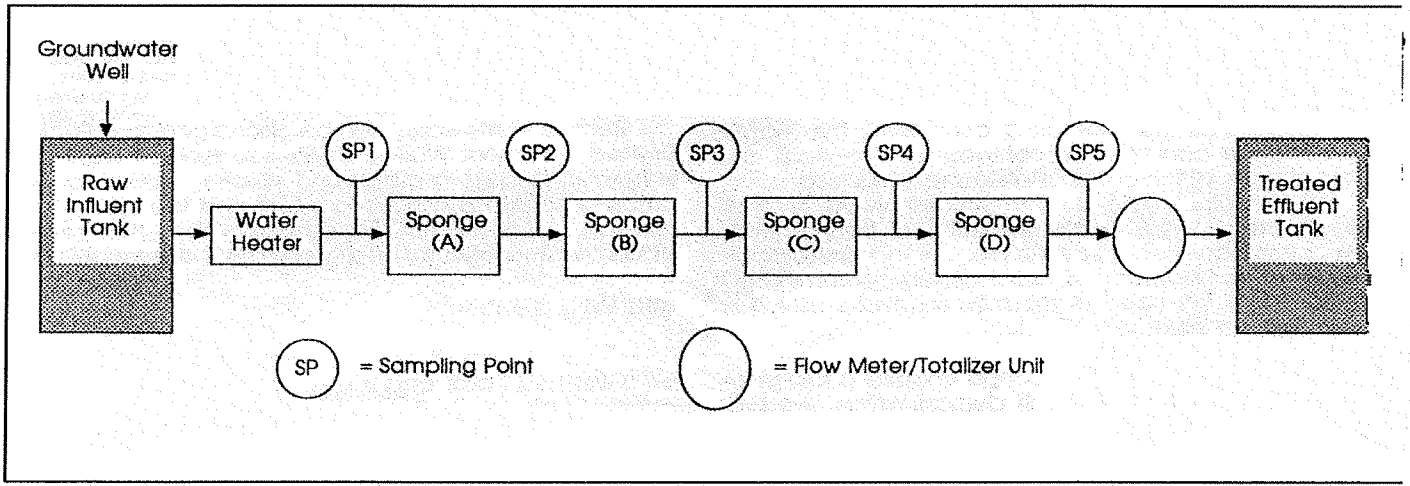


Figure 1. Process flow diagram for the Dynaphore, Inc., Forager™ Sponge demonstration.

Although concentrations of some of the critical metals exceeded cleanup goals for the site, the groundwater was spiked with solutions of lead, copper, and cadmium to as-sure effective evaluation (quantification) of the developer's claim.

Grab samples for analysis of critical parameters were collected from the raw influent, final effluent, and intermediate column effluent points (see Figure 1). In addition, equal volume 24-hr composite samples were collected for total metals, chemical oxygen demand, total suspended solids, total dissolved solids, sulfate, and gross alpha and gross beta radioactivity. Process measurements for flow rate, total volume, pressure, pH, and temperature were also monitored at these locations. Since the developer reported that replacement or regeneration of the columns was not necessary, side tests on laboratory scale columns treating standard metal salt solutions were performed to aid in evaluating the absorption capacity and regenerative capabilities of the Sponge.

Analytical results of critical parameters for the raw influent and final effluent are presented in Table 2 and depicted in Figure 2. These data show that treatment claims for cadmium, copper, and lead were achieved. The developer, however did not achieve treatment claims for chromium. The treatment claim was based on comparing the mean concentration of the raw influent to the mean concentration of the final effluent.

As shown in Figure 2, effective removal of chromium (based on the 50% claim) was achieved within the first 10 hr of operation until performance markedly decreased. The decrease in removal efficiency could be the result of the Sponge's higher affinity for the other critical metals. Although the cadmium claim was met based on the overall effluent average, final effluent cadmium concentrations were below desired performance levels (107 ug/L) at approximately the 61st hr of operation. This is due to the lower than anticipated absorption capacity for cadmium which resulted in saturation of the first two columns within the test period.

The technology had the greatest efficiency for copper. One column was sufficient to meet the developer's 90% removal claim for approximately 53 hr of the 72-hr test. Copper concentrations for columns 2.3, and 4. were at or near detection limits throughout the demonstration test. With regard to lead, three columns were sufficient to meet the developer's 90% claim for approximately 61 hr of the demonstration test.

Although claims for cadmium and lead were met, some of the columns became saturated with these metals during the demonstration. Specifically, the first column became saturated with both cadmium and lead, while the second column became saturated with only cadmium. Saturation is deflned when the effluent concenlration of a given metal is approximately equal to or greater than the influent concentration The first column was saturated with both cadmium and lead at approximately the 49th hr. Approximately 10 hr later, cadmium saturated the second column. None of the columns were saturated with copper during the demonstration test. Based on a non-linear extrapolation of the data, the first column would have become saturated with copper after approximately 4 days of continuous operation.

Based on data from the 72-hr demonstration, the actual absorption capacity for the critical metals was significantly lower (approximately 10 to 100 times lower) than the developer's predemonstration estimates. These estimates were based on absorption capacity tests on standard metal salt solutions rather than the groundwater. The developer theorizes that anion species such as sulfate and phosphate may have interfered with the effective removal of these metals. These results show the need to conduct treatability tests on each wastestream proposed for treatment to determine the true absorption capacity of the system prior to Implementing the technology.

Effective removal of cadmium, copper, and lead was achieved in the presence of a groundwater pH ranging from 3.1-3.8, a sulfate concentration of approximately 20,000 mg/L, a TDS concentration of approximately 23,000 mg/L, and disproportionately higher concentrations of other cations such as magnesium (72 mg/L), potassium (82 mg/L), aluminum (149 mg/L), calcium (224 mg/L), and sodium (6,000 mg/L).The technology's low affinity for these cations was supported by the near zero removal rates of these ions. Table 3 presents a summary of data for the non-critical heavy metals.

In addition to the regeneration of the small test columns, the developer conducted regeneration tests in his laboratory on Sponge cubes taken from the demonstration columns. Both tests showed that regeneration is feasible for lead, copper, and cadmium. Regeneration of chromium was evaluated only for the small test columns and showed only partial regeneration.

The cost to treat heavy metal contaminated groundwater over a one year period with the Dynaphore, Inc. Forager™ Sponge Technology is estimated at $340/1,000 gal. assuming the Sponges are not regenerated and are replaced upon saturation and $238/1,000 gal, assuming the Sponges are regenerated twice providing for three

Table 2. Treatment Performance for Critical Metals

Parameter	*90% Confidence Interval for Avg. Influent Conc. (ug/L)*	*90% Confidence Interval for Avg. Effluent Conc. (ug/L)*	*90% Confidence Interval for Percent Removal (%)*	*Developer's Treatment Claim (%)*
Cadmium		*56 ± 13*	*9 ±2.7*	*80*
Chromium	*426 ± 31*	*290 ± 30*	*32 ±5.8*	*50*
Copper	*917 ± 14*	*25 ± 0*	*97 ± .04*	*90*
Lead	*578 ± 12*	*18 ± 3*	*97 ± .59*	*90*

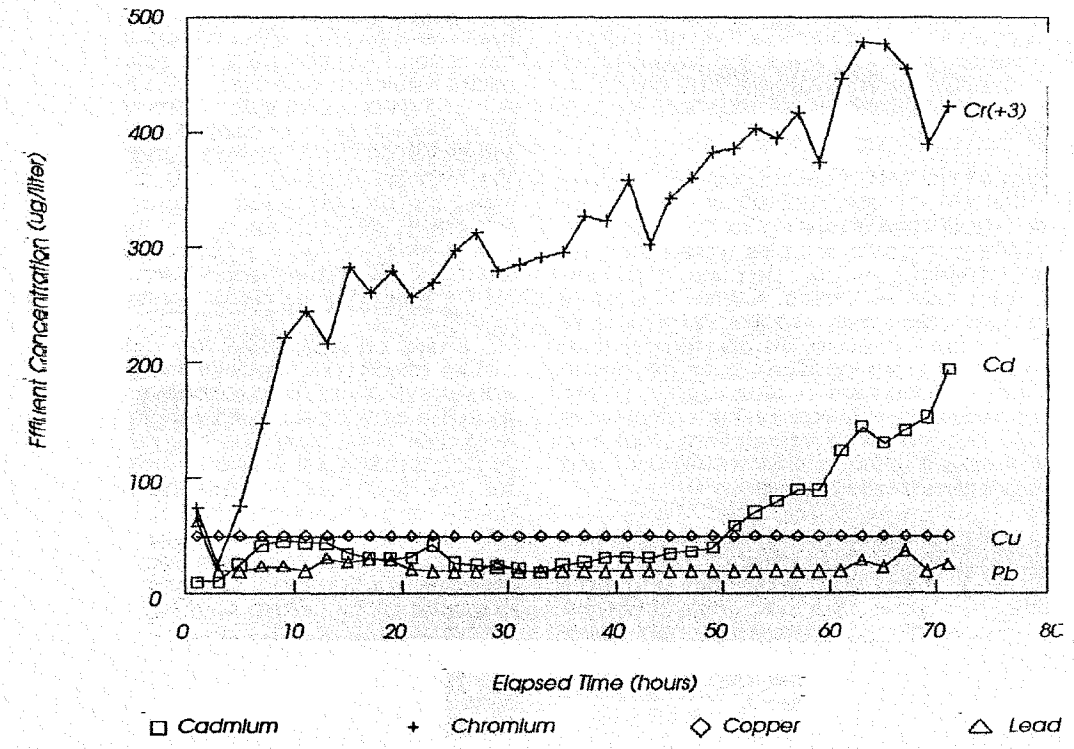


Figure 2. Final effluent-critical metals.

Table 3. Data Summary for Non-Critical Heavy Metals

Parameter	Avg. Influent Conc. (ug/L)	Avg. Effluent Conc. (ug/L)	Avg. Total % Removal
Aluminum	149,000	152,000	-2
Arsenic	47.7	44.4	7
Barium	50.2	46.3	8
Beryllium	15.9	13.9	13
Calcium	224,000	248,000	-11
Cobalt	176	146	17
Iron	199,000	199,000	0
Lithium	460	473	-3
Magnesium	71,700	72,300	-1
Manganese	5870	5880	-1
Mercury	0.39	0.21	46
Nickel	378	107	72
Phosphorus	1520	557	63
Potassium	82,300	83,700	-2
Sodium	6,030,000	6,130,000	-2
Strontium	557	562	-1
Vanadium	1310	53.2	96
Zinc	1300	1190	9

useful treatment cycles. This cost estimate assumes groundwater characteristics are similar to the demonstration groundwater and cadmium, lead, and copper are treated to demonstration performance claims utilizing a four-column, pump-and-treat unit similar to the demonstration unit. The system would operate 24 hr a day, 7 days a week at a flow rate of 1 gpm resulting in a total treatment volume of approximatley 525,000 gal.

A significant portion of the cost is attributable to the frequent replacement or regeneration of the Sponges due to the limited absorption capacity for cadmium in this groundwater. The developer believes that a modification of the polymer may improve its overall adsorption capacity for the critical metals which would greatly aid in lowering treatment costs. Additionally, further cost reduction may be achieved through the use of larger scale units which could handle higher flow rates (see below) and the use of an industrial compactor to compact Sponges to lower disposal costs.

Technology Status

To date, this SITE demonstration represents the first full-scale use of this technology. The trailer mounted-unit was built exclusively for this SITE Demonstration. This unit can be modified to include additional columns of the same size. Additionally, a larger scale unit can also be constructed. This unit uses larger columns and would be just as effective as the smaller system, but could operate at approximately double the flow rate.

Dynaphore, Inc. has formed a liaison with a known environmental remediation firm, Adtechs Corporation of Herndon, VA, to provide the necessary expertise in performing full-scale remediations at contaminated waste sites.

Potential in-situ applications, as previously discussed, may be promising. However, insufficient data is currently available which demonstrates the viability of this treatment option. The effectiveness and cost of in-situ applications have not been evaluated in this study nor has the developer commercially utilized the technology in these applications. EPA is, however, planning to conduct a second demonstration which will evaluate the technology in an in-situ scenario.

Disclaimer

While the technology conclusions presented in this report may not change, the data has not been reviewed by the Quality Assurance/Quality Control Office.

Source of Further Information

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Environmental Protection Agency
Center for Environmental Research Information
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ATTACHMENT 2

2010 Downspout Stormwater Treatment Testing Results

ATTACHMENT 2
2010 DOWNSPOUT SW TREATMENT TESTING
ALASKAN COPPER FACILITY
SEATTLE, WASHINGTON

SAMPLE ID	COPPER	ZINC
Benchmark Values	**14**	**117**
"A" 3317 PRE-RAIN GARDEN	607	9,130
"AA" 3317 POST-RAIN GARDEN	5.15	1,010
Percent Removal	99%	89%
"B" 3317 PRE-DOWN SPOUT FILTER	221	14,900
"BB" 3317 POST-DOWN SPOUT FILTER	7.24	2,770
Percent Removal	97%	81%
"C" 3405 PRE-RAIN GARDEN	26.8	574
"CC" 3405 POST-RAIN GARDEN	23.2	42.8
Percent Removal	13%	93%
"D" 3405 PRE-DOWN SPOUT FILTER	21.1	182
"DD" 3405 POST-DOWN SPOUT FILTER	11.9	132
Percent Removal	44%	27%

Results are reported in ug/L (ppb)
Meets Benchmark -
Does Not Meet Benchmark -

Down Spout Filter = CleanWay downspout filter with metals-adsorbing media.

ATTACHMENT 3

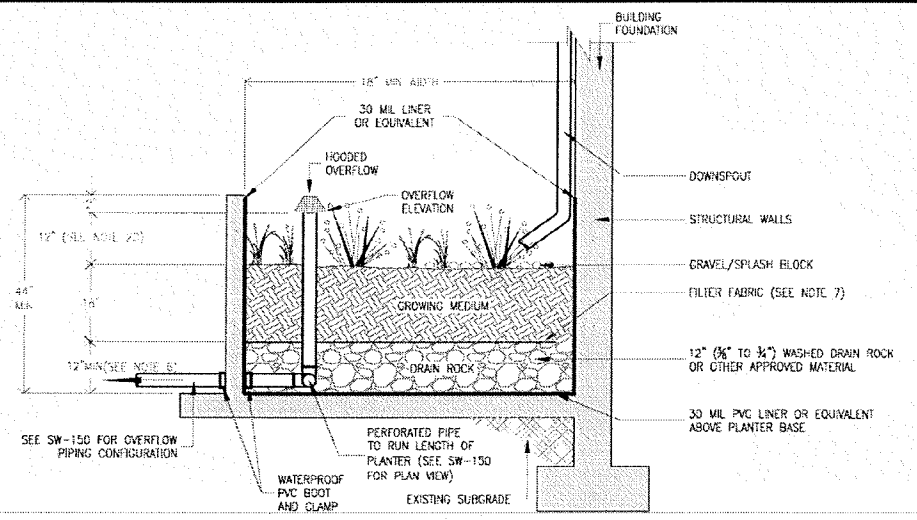
Oyster Shell Treatment Effectiveness

ATTACHMENT 3
OYSTER SHELL TREATMENT EFFECTIVENESS
EXAMPLE PERFORMANCE DATA FROM ANOTHER SEATTLE AREA FACILITY

	Total Copper Influent Concentration (µg/L)					Total Copper Effluent Concentration (µg/L)	
Monitoring Event	CB-22	CB-23	CB-25	Mean		MH-1	Percent Reduction
3Q10	83	64	-	73.5		25	66%
4Q10	82	65	20	55.7		12	78%
1Q11	12	15	8.2	11.7		3.8	68%
						Average Percent Reduction =	71%
	Total Zinc Influent Concentration (µg/L)					Total Zinc Effluent Concentration (µg/L)	
Monitoring Event	CB-22	CB-23	CB-25	Mean		MH-1	Percent Reduction
3Q10	280	380	-	330		76	77%
4Q10	500	300	87	295.7		52	82%
1Q11	57	130	42	76.3		30	61%
						Average Percent Reduction =	73%

ATTACHMENT 4

Rain Garden Planter Specifications



1. Provide protection from all vehicle traffic, equipment staging, and foot traffic in proposed infiltration areas prior to, during, and after construction.

2. Dimensions:
   a. Width of flow-through planter: 18" minimum.
   b. Width of infiltration planter: 30" minimum.
   c. Depth of planter (from top of growing medium to overflow elevation). Simplified: 12"; Presumptive: 6"- 18".
   d. Slope of planter: 0.5% or less.

3. Setbacks (from centerline of facility):
   a. Infiltration planters must be 10' from foundations and 5' from property lines.
   b. Flow-through planters must be less than 30" in height above surrounding area if within 5 feet of property line.

4. Overflow:
   a. Overflow required for Simplified Approach.
   b. Inlet elevation must allow for 2" of freeboard, minimum.
   c. Protect from debris and sediment with strainer or grate.

5. Piping: shall be ABS Sch.40, cast iron, or PVS Sch.40. 3" pipe required for up to 1,500 sq ft of impervious area, otherwise 4" min. Piping must have 1% grade and follow the Uniform Plumbing Code.

6. Drain rock:
   a. Size for infiltration planter: 1½" - ¾" washed
   b. Size for flow-through planter: ¾" washed
   c. Depth for Simplified: 12"
   d. Depth for Presumptive: 0-48", see calcs.

7. Separation between drain rock and growing medium: Use filter fabric (see SWMM Exhibit 2-4 Geotextile table) or a gravel lens (¾ - ¼ inch washed, crushed rock 2 to 3 inches deep).

8. Growing medium:
   a. 18" minimum
   b. See Appendix F.3 for specification or use sand/loam/compost 3-way mix.

9. Vegetation: Follow landscape plans otherwise refer to plant list in SWMM Appendix F. Minimum container size is 1 gallon. # of plantings per 100sf of facility area:
   a. Zone A (wet) 115 herbaceous plants, OR
   b. Zone A (wet) 100 herbaceous plants and 4 small shrubs.

10. Planter walls:
   a. Material shall be stone, brick, concrete, wood, or other durable material (no chemically treated wood).
   b. Concrete, brick, or stone walls shall be included on foundation plans.

11. Waterproof liner: Shall be 30 mil PVC or equivalent, for flow-through facilities.

12. Install washed pea gravel or river rock to transition from inlet or splash pad to growing medium.

13. Inspections: Call BDS IVR Inspection Line, (503) 823-7000, for appropriate inspections.

- DRAWING NOT TO SCALE -

STORMWATER MANAGEMENT MANUAL TYPICAL DETAILS

- Simplified / Presumptive Design Approach -

Planter

NUMBER

SW-130

Bureau of Environmental Services

ATTACHMENT 5

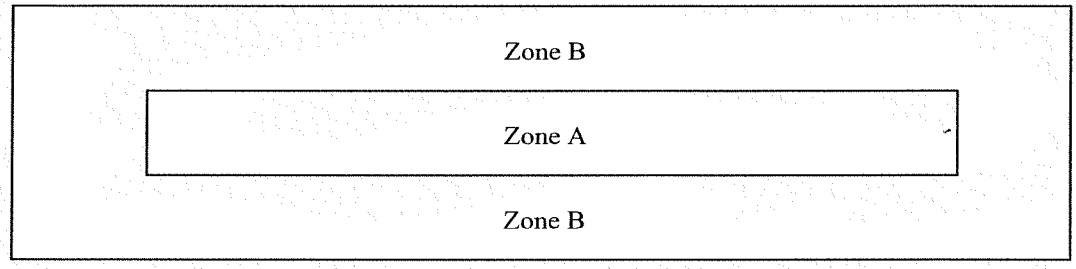
Rain Garden Planter Plant-List

APPENDIX F.4 PLANT LISTS

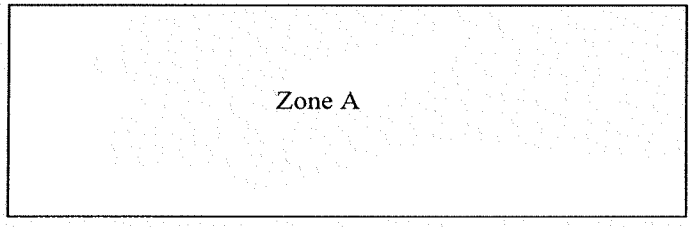
Zone A: Area of the facility defined as the bottom of the facility to the designed high water mark. This area has moist to wet soils and plants located here shall be tolerant of mild inundation.

Zone B: Area of the facility defined as the side slopes from the designed high water line up to the edge of the facility. This area typically has dryer to moist soils, with the moist soils being located further down the side slopes. Plants here should be drought tolerant and help stabilize the slopes.

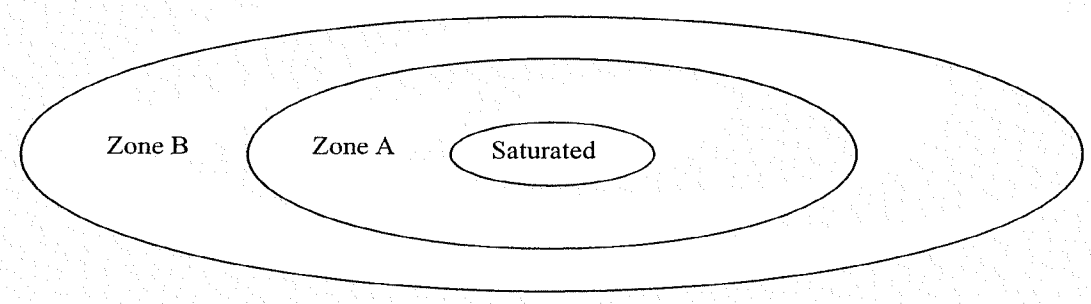
Swale Planting Zones



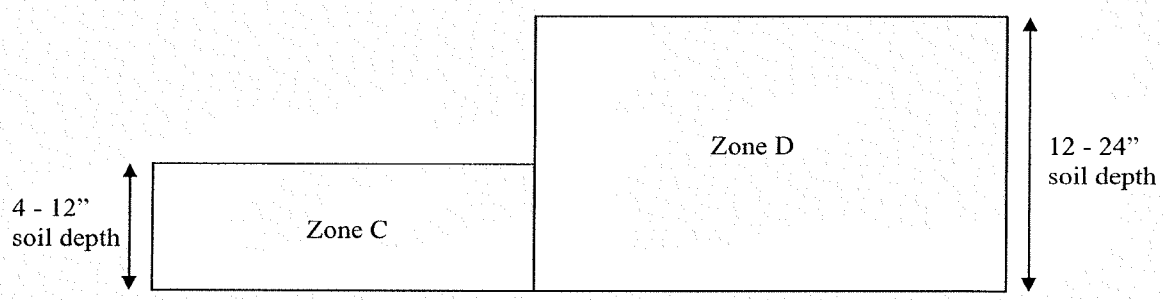
Planter Planting Zones



Basin Planting Zones



Ecoroof Planting Zones



Grassy Swale Native Seed Mix

Percentages are by weight:

Hordeum brachyantherum (Meadow Barley) = 25%
Danthonia californica (California Oat-grass) = 15%
Elymus glaucus (Blue Wild Rye) = 10%
Bromus carinatus (California Brome) = 10%
Festuca romerii (Roemer's fescue) = 10%
Deschampsia cespitosa (Tufted hairgrass) = 10%
Agrostis exarata (Spike bentgrass) = 10%
Alopecurus geniculatus (Water foxtail) = 5%
Deschampsia elongata (Slender hairgrass) = 5%

Facility Plant List

Plant Name		Proposed Facility Type						Characteristics			
		Private					Public				
Botanic name, Common Name	Zone	Swale	Planter	Basin	Dry Pond	Wet Pond	Basin	NW Native	Evergreen	Potential Hgt.	O.C. Spacing
Herbaceous Plants											
Aster suspicatus , Douglas' Aster	B	X		X				Y	N	36"	12"
Athyrium felix-femina, Lady Fern	B	X		X			X	Y	N	36"	24"
Blechnum spicant, Deer Fern	B	X		X			X	Y	N	24"	24"
Bromus carinatus, Califonia Brome Grass	A			X			X	Y	Y	18"	12"
Bromus sitchensis, Alaska Brome	A			X			X	Y	Y	18"	12"
Bromus vulgaris, Columbia Brome	A			X			X	Y	Y	18"	12"
Camassia leichtlinii , Camas Lily	A	X	X	X				Y	N	24"	12"
Camassia quamash , Common Camas	A/B	X	X	X			X	Y	N	24"	12"
Carex deweyanna, Dewey Sedge	A	X	X	X			X	Y	Y	36"	12"
Carex densa , Dense Sedge	A	X	X	X			X	Y	Y	24"	12"
Carex obnupta , Slough Sedge	A	X	X	X			X	Y	Y	4'	12"
Carex rupestris , Curly Sedge	A	X	X	X				N	Y	14"	12"
Carex stipata , Sawbeak Sedge	A	X	X	X				N	N	20"	12"
Carex testacea , New Zealand Orange Sedge	A	X	X	X			X	N	Y	24"	12"
Carex vesicaria, Inflated Sedge	A	X	X	X			X	Y	N	36"	12"
Deschampsia cespitosa , Tufted Hair Grass	A/B	X	X	X			X	Y	N	36"	12"
Eleocharis acicularis, Needle Spike Rush	A	X	X	X			X	Y	Y	30"	12"
Eleocharis ovata, Ovate Spike Rush	A	X	X	X			X	Y	Y	30"	12"
Eleocharis palustris , Creeping Spike Rush	A			X			X	Y	Y	30"	12"
Elymus glaucus, Blue Wild Rye	B	X		X			X	Y	Y	24"	12"

Facility Plant List

Plant Name		Proposed Facility Type						Characteristics			
		Private					Public				
Botanic name, Common Name	Zone	Swale	Planter	Basin	Dry Pond	Wet Pond	Basin	NW Native	Evergreen	Potential Hgt.	O.C. Spacing
Festuca occidentalis, Western Fescue Grass	A	X		X			X	Y	N	24"	12"
Festuca rubra, Red Fescue	B	X		X			X	Y	Y	24"	12"
Glycera occidentalis, Western Manna Grass	A			X			X	Y	Y	18"	12"
Hebe 'Autumn Glory', Hebe	B	X		X				N	Y	14"	12"
Iris douglasiana, Douglas Iris	B	X		X			X	Y	N	18"	12"
Iris sibirica, Siberian Iris	A	X	X	X				N	N	36"	12"
Iris tenax, Oregon Iris	B	X		X			X	Y	N	18"	12"
Juncus balticus, Baltic Rush	A	X	X	X				N	N	20"	12"
Juncus effusus var. pacificus, Soft rush	A	X	X	X			X	Y	Y	36"	12"
Juncus ensifolius, Dagger-leaf Rush	A	X	X	X			X	N	N	10"	12"
Juncus patens, Spreading Rush	A	X	X	X			X	N	Y	36"	12"
Juncus tenuis, Slender Rush	A	X	X	X			X	Y	Y	36"	12"
Lupinus micranthus, Small Flowered Lupine	B	X		X			X	Y	N	18"	12"
Lupinus polyphyllus, Large-leaved Lupine	A/B	X		X				Y	N	36"	12"
Polypodium glycrrhiza, Licorice Fern	A	X	X	X				Y	Y	12"	12"
Polystichum munitum, Sword Fern	A/B	X		X			X	Y	Y	24"	24"
Pteridium aquilinum, Bracken Fern	B	X		X				Y	Y	5'	12"
Scriptus acutus, Hardstem Bulrush	A	X	X	X				N	N	10"	12"
Scriptus americanus, American Bulrush	A	X	X	X			X	Y	Y	30"	12"
Scriptus mlcrocarpus, Small Fruited Bulrush	A			X			X	Y	Y	24"	12"
Scriptus validus, Softstem Bulrush	A	X	X	X				N	N	5'	12"
Sedum oreganum, Oregon Stonecrop	B	X						Y	Y	4"	12"
Sisyrinchium californicum, Yellow-eyed Grass	A/B	X	X	X				N	Y	6"	12"

Facility Plant List

Plant Name		Proposed Facility Type						Characteristics			
		Private					Public				
Botanic name, Common Name	Zone	Swale	Planter	Basin	Dry Pond	Wet Pond	Basin	NW Native	Evergreen	Potential Hgt.	O.C. Spacing
Veronica liwanensis, Speedwell	A	X		X				N	N	2"	12"
Large Shrubs and Small Trees											
Acer circinatum, Vine Maple	A/B	X	X	X			X	Y	N	15'	10'
Amelanchier alnifolia, Western Serviceberry	B	X		X			X	Y	N	20'	10'
Ceanothus sanguineus, Oregon Redstem Ceanothus	B	X		X			X	Y	Y	7'	4'
Holodiscus discolor, Oceanspray	B	X		X			X	Y	N	6'	4'
Lonicera involucrata, Black Twinberry	B	X		X			X	Y	N	5'	4'
Oemleria cerasiformis, Indian Plum	B	X		X			X	Y	N	6'	4'
Philadelphu lewisii, Wild Mock Orange	B	X		X			X	Y	N	6'	4'
Ribes sanguineum, Red-Flowering Current	B	X		X			X	Y	N	8'	4'
Rubus parviflorus, Thimbleberry	B	X		X			X	Y	N	8'	4'
Rubus spectabilis, Salmonberry	A	X	X	X			X	Y	N	10'	4'
Salix fluviatalis, Columbia Willow	A/B	X	X	X			X	N	N	13'	6'
Salix lucida var. 'Lasiandra', Pacific Willow	A	X	X	X			X	Y	N	13'	6'
Salix purpurea nana, Blue Arctic Willow	B	X		X				N	N	8'	6'
Salix stichensis, Sitka Willow	A	X	X	X			X	Y	N	20'	6'
Sambucus cerulea, Blue Elderberry	B	X		X			X	Y	N	10'	10'
Sambucus racemosa, Red Elderberry	B	X		X			X	Y	N	10'	10'
Spriaea douglasii, Douglas Spiraea	A/B	X	X	X			X	Y	N	7'	4'
Viburnum edule, Highbush Cranberry	A/B	X	X	X			X	Y	N	6'	4'

Facility Plant List

Plant Name		Proposed Facility Type						Characteristics			
		Private					Public				
Botanic name, Common Name	Zone	Swale	Planter	Basin	Dry Pond	Wet Pond	Basin	NW Native	Evergreen	Potential Hgt.	O.C. Spacing
Shrubs											
Ceanothus velutinus, Snowbrush	B	X		X			X	Y	Y	4'	3'
Cornus sericea, Red-twig Dogwood	A	X	X	X			X	Y	N	6'	4'
Cornus sericea 'Kelseyii', Kelsey Dogwood	B	X		X			X	N	N	24"	24"
Gaultheria shallon, Salal	B	X		X			X	Y	Y	24"	24"
Mahonia aquifolium, Oregon Grape	B	X		X			X	Y	Y	5'	3'
Mahonia nervosa, Dull Oregon Grape	B	X		X			X	Y	Y	24"	24"
Physocarpus capitatus, Pacific Ninebark	A/B	X	X	X				Y	N	10'	3'
Rosa gymnocarpa, Baldhip Rose	B	X		X			X	Y	N	3'	3'
Rosa nutkana, Nootka Rose	B	X		X			X	Y	N	8'	3'
Rosa pisocarpa, Swamp Rose	A/B	X	X	X			X	Y	N	8'	3'
Symphoricarpos alba, Common Snowberry	B	X		X			X	Y	N	6'	3'
Groundcovers											
Arctostaphylos uva-ursi, Kinnickinnick	B	X		X				Y	Y	6"	12"
Fragaria chiloensis, Coastal Strawberry	B	X		X				Y	Y	6"	12"
Fragaria vesca, Woodland Strawberry	B	X		X				N	Y	10"	12"
Fragaria virginiana, Wild Strawberry	B	X		X				N	Y	10"	12"
Helictotrichon sempervirens, Blue Oat Grass	B	X		X				N	Y	24"	12"
Mahonia repens Creeping Oregon Grape	B	X		X				Y	Y	12"	12"
Trees											
Abies grandis, Grand Fir	B			X			X	Y	Y	150'	

Facility Plant List

Plant Name		Proposed Facility Type						Characteristics			
		Private					Public				
Botanic name, Common Name	Zone	Swale	Planter	Basin	Dry Pond	Wet Pond	Basin	NW Native	Evergreen	Potential Hgt.	O.C. Spacing
Acer griseum, Paperbark Maple	B	X		X				N	N	30'	
Acer macrophyllum, Big Leaf Maple	B	X		X			X	Y	Y	60'	
Alnus rubra, Red Alder	A	X		X			X	Y	N	80'	
Arbutus menziesii, Madrone	B			X			X	Y	N	35'	
Crataegus douglasii, Black Hawthorn	A	X		X			X	Y	N	40'	10'
Fraxinus latifolia, Oregon Ash	A/B	X		X			X	Y	N	30'	
Malus fusca, Pacific Crabapple	A	X	X	X			X	Y	N	30'	10'
Metasequoia glyptostroboides, Dawn Redwood	B			X			X	N	N	80'	
Populus tremuloides, Quaking Aspen	A			X			X	Y	N	40'	
Prunus emarginata var. mollis, Bitter Cherry	A/B	X	X	X			X	Y	N	50'	
Pseudotsuga menziesii, Douglas Fir	B	X		X			X	Y	Y	200'	
Quercus garryana, Oregon White Oak	B	X		X			X	Y	N	100'	
Rhamnus purshiana, Cascara	A/B	X	X	X			X	Y	N	30'	
Salix hookeriana, Hooker's Willow	A/B	X	X	X			X	Y	N	15'	
Salix scouleriana, Scouler's Willow	A/B	X	X	X			X	Y	N	15'	
Thuja plicata, Western Red Cedar	A			X			X	Y	Y	150'	
Tsuga hetrophylla, Western Hemlock	A	X		X			X	Y	Y	125'	
Tsuga mertensiana, Mountain Hemlock	B	X		X			X	Y	Y	125'	

Ecoroof Plant List

Plant Name	Characteristics						
Botanic name, Common Name	Zone	NW Native	Evergreen	Potential Hgt.	O.C. Spacing	Full Sun	Partial Shade
Sedums and Succulents							
Delosperma ssp., Ice Plant	C	N	Y	4"		X	
Malephora crocea var. purpureo crocea 'Tequila Sunrise', Coppery Mesemb	C	N	Y	10"		X	
Sedum 'Autumn Joy'	C	N	N	24"		X	
Sedum acre, Biting Stonecrop	C	N	Y	2"		X	
Sedum album, White Stonecrop	C	N	Y	3"		X	
Sedum divergens, Pacific Stonecrop	C	N	Y	3"		X	
Sedum hispanicum, Spanish Stonecrop	C	N	Y	3"		X	
Sedum kamtschaticum, Kirin-so	C	N	N	6"		X	
Sedum oreganum, Oregon Stonecrop	C	Y	Y	4"		X	X
Sedum sexangular, Tasteless Stonecrop	C	N	Y	4"		X	
Sedum spathulifolium, Stonecrop	C	Y	Y	4"		X	
Sedum spurium, Two-row Stonecrop	C	N	Y	6"		X	X
Sempervivum tectorum, Hens and Chicks	C	N	Y	6"		X	
Herbaceous Plants							
Achillea millefolium, Common Yarrow	C	N	N	36"		X	
Achillea tomentosa, Wooly Yarrow	C	N	N	8"		X	
Arenaria montana, Sandwort	C	N	N	4"		X	
Artemesia 'Silver Mound', Artemesia	C	N	N	12"		X	
Aurinia saxatilis, 'Compacta'	C	N	N	6"		X	
Castilleja foliosa, Indian Paintbrush	C	Y	N	10"		X	

Ecoroof Plant List

Plant Name	Characteristics							
Botanic name, Common Name	Zone	NW Native	Evergreen	Potential Hgt.	O.C. Spacing	Full Sun	Partial Shade
Dianthus ssp.	C	N	N	12"		X	X
Erigeron discoideus, Fleabane	C	N	N	12"		X	X
Festuca glauca, Blue Fescue	C	N	Y	12"		X	X
Fragaria chiloensis, Coastal Strawberry	C	Y	Y	10"		X	X
Fragaria virginiana, Wild Strawberry	C	Y	Y	10"		X	X
Gaillardia aristata, Birds-eye gilia	C	N	N	20"		X	X
Gazania linearis 'CO Gold', Gazania	C	N	N	6"		X	
Gilia capitata, Blue Thimble Flower	C	Y	N	12"		X	
Koelaria macrantha, June Grass	C	N	N	24"		X	X
Linaria reticulate, Purplenet Toadflax	C	N	N	20"		X	
Lobularia maritima, Sweet Alyssum	C	N	N	12"		X	
Polypodium glycrrhiza, Licorice Fern	C	Y	Y	12"		X	X
Polystichum munitum, Sword Fern	C	Y	Y	24"		X	X
Potentilla nepalensis, Nepal Cinquefoil	C	N	N	14"		X	X
Potentilla neumanniana, Cinquefoil	C	N	N	14"		X	
Thymus serphyllum, Creeping Thyme	C	N	N	3"		X	
Veronica liwanensis, Speedwell	C	N	N	2"		X	X
Shrubs and Small Trees							
Amalanchier alnifolia, Saskatoon Serviceberry	D	Y	N	20'		X	
Berberis thunbergii, Japanese Barberry	D	N	N	4'		X	

Ecoroof Plant List

Plant Name	Characteristics						
Botanic name, Common Name	Zone	NW Native	Evergreen	Potential Hgt.	O.C. Spacing	Full Sun	Partial Shade
Gaultheria shallon, Salal	D	Y	Y	24"		X	X
Lavandula angustifolia 'Hidcote', Dwarf English Lavander	D	N	Y	30"		X	
Mahonia aquifolium, Oregon Grape	D	Y	Y	5'		X	X
Mahonia nervosa, Dull Oregon Grape	D	Y	Y	24"		X	X
Mahonia repens, Creeping Oregon Grape	D	Y	Y	12"		X	X
Nanadina domestica, Heavenly Bamboo	D	N	N	4'		X	X
Ribes sanguineum, Red-Flowering Current	D	Y	N	12'		X	X
Rosa nutkana, Nootka Rose	D	Y	N	10'		X	
Symphoricarpos mollis, Creeping Snowberry	D	Y	N	18"		X	X
Thymus vulgaris, Common Thyme	D	N	Y	12"		X	X

Greenstreet Plant List

Plant Name		Facility Type			Characteristics				
		Public							
Botanic name, Common Name	Zone	Swale	Curb Extension	Planter	NW Native	Evergreen	Potential Hgt.	O.C. Spacing	Under Powerlines
Herbaceous Plants									
Camassia leichtlini, Great Camas	A/B	X	X	X	Y	N	24"	12"	
Camassia quamash, Common Camas	A/B	X	X	X	Y	N	24"	12"	
Carex comans, New Zealand Hair Sedge	A	X	X	X		Y	18"	12"	
Carex densa, Dense Sedge	A	X	X	X	Y	Y	24"	12"	
Carex obnupta, Slough Sedge	A	X	X	X	Y	Y	4'	12"	
Carex stipata, Sawbeak Sedge	A	X	X	X	N	N	20"	12"	
Carex testacea, New Zealand Orange Sedge	A	X	X	X	N	Y	24"	12"	
Deschampsia cespitosa, Tufted Hair Grass	A/B	X	X	X	Y	N	36"	12"	
Iris douglasiana, Douglas Iris	B	X	X		Y	N	18"	12"	
Iris tenax, Oregon Iris	B	X	X		Y	N	18"	12"	
Juncus patens, Spreading Rush	A	X	X	X	N	Y	36"	12"	
Polystichum munitum, Sword Fern	A/B	X	X		Y	Y	24"	24"	
Shrubs									
Cornus sericea 'Kelseyii', Kelsey Dogwood	A/B	X	X	X	N	N	24"	24"	
Euonymous japonicus 'Microphyllus' Boxleaf Evergreen Euonymus	B	X	X		N	Y	24"	24"	
Gaultheria shallon, Salal	B	X	X		Y	Y	24"	24"	
Lavandula angustifolia 'Hidcote Blue', Dwarf Lavander	B	X	X		N	N	24"	24"	
Mahonia nervosa, Dull Oregon Grape	B	X	X		Y	Y	24"	24"	

Greenstreet Plant List

Plant Name		Facility Type			Characteristics				
		Public							
Botanic name, Common Name	Zone	Swale	Curb Extension	Planter	NW Native	Evergreen	Potential Hgt.	O.C. Spacing	Under Powerlines
Spirarea betulifolia, Birchleaf Spiraea	A/B	X	X	X	Y	N	24"	24"	
Spiraea densiflora, Sub-alpine Spiraea	A/B	X	X	X	Y	N	24"	24"	
Rosmarinus officinalis 'Huntington Blue Carpet', Creeping Rosemary	B	X	X		N	N	12"	24"	
Viburnum opulus 'Nanum', Dwarf European Cranberry	B	X	X		N	N	24"	24"	
Groundcovers									
Arctostapylos uva-ursi, Kinnickinnick	B	X	X		Y	Y	6"	12"	
Fragaria chiloensis, Coastal Strawberry	B	X	X		Y	Y	6"	12"	
Fragaria vesca, Woodland Strawberry	B	X	X		Y	Y	6"	12"	
Fragaria virginiana, Wild Strawberry	B	X	X		N	Y	10"	12"	
Helictotrichon sempervirens, Blue Oat Grass	B	X	X		N	Y	24"	12"	
Mahonia repens Creeping Oregon Grape	B	X	X		Y	Y	12"	12"	
Street Trees									
Acer campestre 'Evelyn', Queen Elizabeth Hedge Maple	A/B	X	X	X	N	N	30'		N
Betula jacquemontii, Jacquemontii Birch	A/B	X	X	X	N	N	60'		N
Carpinus caroliniana, American Hornbeam	A/B	X	X	X	N	N	30'		Y
Celtis occidentalis, Hackberry	A/B	X	X	X	N	N	50'		N
Fraxinus pennsylvanica 'Johnson', Leprechaun Ash	A/B	X	X	X	N	N	30'		Y

Greenstreet Plant List

Plant Name		Facility Type			Characteristics				
		Public							
Botanic name, Common Name	Zone	Swale	Curb Extension	Planter	NW Native	Evergreen	Potential Hgt.	O.C. Spacing	Under Powerlines
Gleditsia triacanthos 'Impcole', Imperial Honeylocust	A/B	X	X	X	N	N	30'		Y
Gleditsia triacanthos 'Skycole', Skyline Honeylocust	A/B	X	X	X	N	N	70'		N
Koelreuteria paniculata, Goldenrain Tree	A/B	X	X	X	N	N	30'		Y
Nyssa sylvatica, Black Tupelo	A	X	X	X	N	N	50'		N
Prunus virginiana 'Canada Red', Canada Red Chokecherry	A/B	X	X	X	N	N	25'		Y
Quercus shumardii, Shumard Oak	A/B	X	X	X	N	N	70'		N
Rhamnus purshiana, Cascara	A/B	X	X	X	Y	N	30'		Y

Pond Plant List

Plant Name	Planting Zone			Characteristics			
Botanic name, Common Name	Wet to Saturated	Moist to Dry	Dry/Upland	NW Native	Evergreen	Potential Hgt.	O.C. Spacing
Herbaceous Plants							
Alisma plantago-aquatica, Water Plantain	X			Y	N	24"	12"
Alopecurus geniculatus, Water Foxtail		X		Y	Y	18"	12"
Aster suspicatus , Douglas' Aster	X	X		Y	N	36"	12"
Bidens cernua, Nodding Beggerticks		X		Y	N	24"	12"
Blechnum spicant, Deer Fern	X	X		Y	N	24"	24"
Bromus sitchensis, Alaska Brome		X	X	Y	Y	18"	12"
Camassia quamash , Common Camas		X		Y	N	24"	12"
Carex deweyanna, Dewey Sedge	X	X		Y	Y	36"	12"
Carex obnupta , Slough Sedge	X			Y	Y	4'	12"
Deschampsia cespitosa , Tufted Hair Grass		X		Y	N	36"	12"
Eleocharis ovata, Ovate Spike Rush	X			Y	Y	30"	12"
Eleocharis palustris , Creeping Spike Rush	X			Y	Y	30"	12"
Elymus glaucus, Blue Wild Rye		X		Y	Y	24"	12"
Glycera occidentalis, Western Manna Grass	X	X		Y	Y	18"	12"
Lemna minor, Common Lesser Duckweed	X						
Juncus effusus var. pacificus , Soft rush	X	X		Y	Y	36"	12"
Juncus ensifolius , Dagger-leaf Rush	X	X		Y	Y	24"	12"
Juncus oxymeris, Pointed Rush	X	X		Y	Y	24"	12"

Pond Plant List

Plant Name	Planting Zone			Characteristics			
Botanic name, Common Name	Wet to Saturated	Moist to Dry	Dry/Upland	NW Native	Evergreen	Potential Hgt.	O.C. Spacing
Juncus patens , Spreading Rush	X	X		N	Y	36"	12"
Juncus tenuis, Slender Rush	X	X		Y	Y	36"	12"
Lupinus polyphyllus , Large-leaved Lupine		X		Y	N	36"	12"
Myosotis laxa, Small-flowered Forget-Me-Not	X			Y	N	18"	12"
Polystichum munitum , Sword Fern	X	X		Y	Y	24"	24"
Sagittaria latifolia, Wapato	X			Y	N	24"	12"
Potamogeton natans, Floating-leafed Pondweed	X			Y	Y	18"	12"
Scriptus acutus , Hardstem Bulrush	X			N	N	10"	12"
Scriptus mlcrocarpus, Small Fruited Bulrush		X		Y	Y	24"	12"
Sisyrinchium idahoense Blue-eyed Grass		X		N	Y	6"	12"
Sparganium emersum, Narrowleaf Bur-reed	X			Y	N	24"	12"
Veronica liwanensis , Speedwell	X	X		N	N	2"	12"
Viola palustris, Marsh Violet	X	X		Y	N	6"	6"
Large Shrubs and Small Trees							
Acer circinatum , Vine Maple	X	X		Y	N	15'	10'
Amelanchier alnifolia , Western Serviceberry			X	Y	N	20'	10'
Holodiscus discolor, Oceanspray			X	Y	N	6'	4'
Lonicera involucrata , Black Twinberry			X	Y	N	5'	4'
Oemleria cerasiformis, Indian Plum		X	X	Y	N	6'	4'
Philadelphu lewisii, Wild Mock Orange			X	Y	N	6'	4'

Pond Plant List

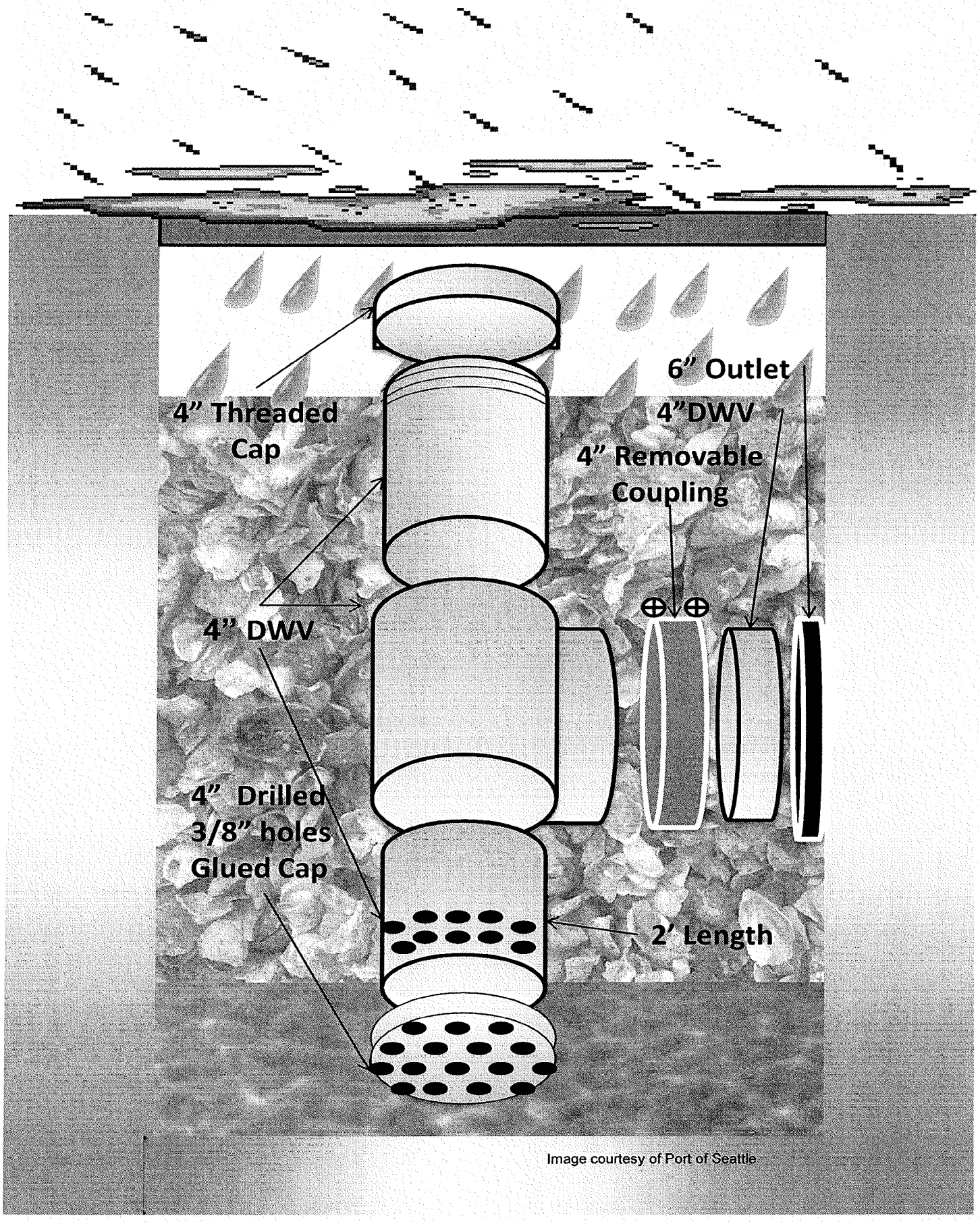
Plant Name	Planting Zone			Characteristics			
Botanic name, Common Name	Wet to Saturated	Moist to Dry	Dry/Upland	NW Native	Evergreen	Potential Hgt.	O.C. Spacing
Ribes sanguineum , Red-Flowering Current			X	Y	N	8'	4'
Rubus parviflorus , Thimbleberry		X		Y	N	8'	4'
Rubus spectabilis , Salmonberry	X	X		Y	N	10'	4'
Salix fluviatalis, Columbia Willow	X	X		N	N	13'	6'
Salix lucida var. 'Lasiandra' , Pacific Willow	X	X		Y	N	13'	6'
Salix stichensis , Sitka Willow	X	X		Y	N	20'	6'
Sambucus racemosa, Red Elderberry		X		Y	N	10'	10'
Spriaea douglasii , Douglas Spiraea		X		Y	N	7'	4'
Viburnum edule, Highbush Cranberry		X		Y	N	6'	4'
Shrubs							
Cornus sericea , Red-twig Dogwood	X	X		Y	N	6'	4'
Fragaria vesca , Woodland Strawberry		X	X	N	Y	10"	12"
Fragaria virginiana , Wild Strawberry		X	X	N	Y	10"	12"
Mahonia aquifolium , Oregon Grape		X	X	Y	Y	5'	3'
Mahonia nervosa , Dull Oregon Grape		X		Y	Y	24"	24"
Physocarpus capitatus , Pacific Ninebark	X			Y	N	6'	3'
Rosa gymnocarpa, Baldhip Rose	X			Y	N	3'	3'
Rosa nutkana , Nootka Rose		X		Y	N	8'	3'
Rosa pisocarpa , Swamp Rose	X			Y	N	8'	3'

Pond Plant List

Plant Name	Planting Zone			Characteristics			
Botanic name, Common Name	Wet to Saturated	Moist to Dry	Dry/Upland	NW Native	Evergreen	Potential Hgt.	O.C. Spacing
Spiraea betulifolia, Birchleaf Spiraea		X		Y	N	24"	24"
Symphoricarpus alba, Snowberry		X		Y	N	3'	3'
Trees							
Abies grandis, Grand Fir		X		Y	Y	150'	
Acer macrophyllum, Big Leaf Maple		X		Y	Y	60'	
Alnus rubra , Red Alder	X	X		Y	N	80'	
Arbutus menziesii, Madrone			X	Y	N	35'	
Cornus nuttalii, Western flowering Dogwood		X	X	Y	N	20'	
Crataegus douglasii , Black Hawthorn	X			Y	N	40'	
Fraxinus latifolia , Oregon Ash	X	X		Y	N	30'	
Malus fusca , Pacific Crabapple	X	X		Y	N	30'	
Pinus ponderosa, Ponderosa Pine			X	Y	Y	70'	
Pinus monticola, Western White Pine		X	X	Y	Y	90'	
Prunus emarginata var. mollis, Bitter Cherry	X			Y	N	50'	
Pseudotsuga menziesii , Douglas Fir		X		Y	Y	200'	
Quercus garryana , Oregon White Oak		X		Y	N	100'	
Rhamnus purshiana , Cascara	X			Y	N	30'	
Salix hookeriana, Hooker's Willow	X	X		Y	N	15'	
Salix scouleriana, Scouler's Willow	X	X		Y	N	15'	
Thuja plicata , Western Red Cedar	X	X		Y	Y	150'	

ATTACHMENT 6

Oyster Shell Catch Basin Drainage Configuration


4" Threaded
Cap
6" Outlet
4"DWV
4" Removable
Coupling
4" DWV
4" Drilled
3/8" holes
Glued Cap
2' Length
Image courtesy of Port of Seattle